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THE VIRGINIA JOURNAL OF SCIENCE

A JOURNAL ISSUED QUARTERLY BY THE
VIRGINIA ACADEMY OF SCIENCE



Vol. 12, New Series

September, 1961

No. 4



VOL. 12, NEW SERIES

No. 4

SEPTEMBER, 1961

THE VIRGINIA JOURNAL OF SCIENCE

PUBLISHED FOUR TIMES A YEAR IN JANUARY, APRIL, JULY, AND
SEPTEMBER, BY THE VIRGINIA ACADEMY OF SCIENCE

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CONTENTS

	Pages
Committee Reports	122
Abstracts of Papers Presented at the Annual Meeting	143
List of Members	213

EDITORIAL BOARD

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February 9, 1962

THE VIRGINIA JOURNAL OF SCIENCE

VOL. 12, NEW SERIES

No. 4

VIRGINIA ACADEMY OF SCIENCE



Proceedings for the Year
1960 – 1961

MINUTES OF THE THIRTY-NINTH ANNUAL MEETING

MAY 10, 11, 12, 13, 1961

VIRGINIA MILITARY INSTITUTE
LEXINGTON, VIRGINIA

MINUTES OF THE ACADEMY CONFERENCE

May 11, 1961

President Bell called the meeting to order at 8:00 P.M. The Treasurer's report was given by Mr. Foley Smith and Col. Heflin made pertinent announcements for the Local Arrangements Committee. The Chairmen of the Committees of the Academy reported briefly and these are published elsewhere in this issue.

The matter of the proposed constitutional change for sectional representation on Council, as discussed in the Council meeting of the same day, was explained. The wording of Article 6 as changed and approved by Council was read and accepted by the Conference. The rotational plan as proposed from the Long Range Planning Committee and approved by Council was read by Dr. Flory and approved by the Conference. Detailed reports on the agenda follow.

Adjournment

Paul M. Patterson, Secretary

**TENTATIVE REWORDING OF ARTICLE 6 OF
CONSTITUTION VIRGINIA ACADEMY OF
SCIENCE**

The executive body of this organization shall be known as the Council. It shall be composed of the President, the President-Elect, the Secretary, the Treasurer, the Assistant Secretary-Treasurer, the three most recent Past Presidents, and one member elected by each Section of the Academy. The members from the several Sections shall be elected for three year terms, on a rotational basis among the Sections. In addition to the above listed members, the following shall be ex-officio members of the Council: (1) the Editor, (2) the Chairman of the Long Range Planning Committee; (3) the Chairman of the Research Committee, and (4) the Chairman of the Committee for the Virginia Junior Academy of Science. In the case of death or other unforeseen interruption of this routine, the President shall make interim appointments until the next annual election is held.

TABULATION OF REGISTRATION

A total of 739 persons registered for the 1961 meeting. Of these 144 represented the V.J.A.S. Section registrations were: Agricultural Sciences, 29 members, 19 nonmembers, total 48; Astronomy, Mathematics and

Physics, 35 members, 22 nonmembers, total 57; Bacteriology, 8 members, 7 nonmembers, total 15; Biological Sciences, 70 members, 30 nonmembers, total 100; Chemistry, 74 members, 42 nonmembers, total 116; Engineering, 7 members, 18 nonmembers, total 25; Geology, 24 members, 28 nonmembers, total 52; Medical Sciences, 26 members, 20 nonmembers, total 46; Psychology, 19 members, 5 nonmembers, total 24; Science teachers, 15 members, 14 nonmembers, 29 total; Statistics, 7 members, 12 nonmembers, total 19; No section preference, 6 members, 58 nonmembers, total 64. There were 320 members in attendance, and 275 nonmembers.

TREASURER'S REPORT
VIRGINIA ACADEMY OF SCIENCE
GENERAL FUND

BALANCE ON DEPOSIT—JANUARY 1, 1960 \$ 2,397.89

RECEIPTS:

Revenue:

Dues:

Life members	\$ 150.00
Business members	1,700.00
Sustaining members	500.00
Contributing members	875.00
Regular members	1,785.00
Student members	26.00
Delinquent dues	111.00
	5,147.00

Gifts, grants and bequests:

Virginia Junior Academy of Science	770.00
General	252.00

Non-Revenue:

Advance Payment of Dues	22.00
Major W. Catesby Jones Award Fund	10.00

Receipts from annual meeting, May, 1960:

Fees for exhibit space	\$1,170.00
------------------------------	------------

Registration fees	361.35
	1,531.35

Refunds of advances on meeting expense	76.32
--	-------

Sale of James River Basin books	21.00
---------------------------------------	-------

Dividends on stock investments	105.40
--------------------------------------	--------

Income from Special Trust Fund	
--------------------------------------	--

(Exhibit G)	411.34
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Total Receipts	8,346.41
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Total Fund Available	\$10,744.30
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SEARCHED
INDEXED
SERIALIZED
FILED

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DISBURSEMENTS:

Annual meeting expense	\$ 913.06
American Association for the Advancement of Science Meeting	234.19
Virginia Junior Academy of Science	2,142.45
Postage and express	207.57
Programs printed for annual meeting	434.00
Printing	423.12
Science Talent Search	114.46
Stationery, supplies and stenographic service	56.85
Virginia Journal of Science	2,000.00
Miscellaneous and general expense (Schedule B-1)	544.20
Dr. E. C. L. Miller Award	50.00
Major W. Catesby Jones Award	10.00
 Total Disbursements	 7,129.90

BALANCE ON DEPOSIT—DECEMBER 31, 1960

(Exhibit A)	\$ 3,614.40
 Foley F. Smith, Treasurer	 _____

REPORT OF THE BUSINESS MEMBERSHIP COMMITTEE

The business membership of the Academy includes the following: Allied Chemical Corporation, The American Tobacco Company, The Dow Chemical Company, First and Merchants National Bank, General Electric Company, Larus and Brother Company, Inc., Merck and Company, Inc., Philip Morris and Company, Ltd., Inc., The Newport News Shipbuilding and Drydock Company, Norfolk and Western Railway Company, Phipps and Bird, Inc., A. H. Robins Company, Inc., Reynolds Metal Company, State-Planters Bank of Commerce and Trusts, Virginia-Carolina Chemical Corporation.

The continued support of these companies is a boon to the Academy activities. Business members are appropriately listed in the *Virginia Journal of Science* and certificates have been provided to all.

E. S. Harlow, Chairman

REPORT OF THE MEMBERSHIP COMMITTEE

A program was adopted whereby each member of the Membership Committee prepared a list of prospective members according to the scientific area of the committee man. Special letters were then mailed to 300 persons, 56 of which enrolled in the Academy as members. An additional number, estimated at about 45, also joined the Academy, largely because of the activity of the Membership Committee.

In addition to the approach adopted this year, the chairman thought that consideration should be given to rotation of the committee and its members among the several educational institutions of the state, so that all might share in the responsibility of securing new members for the Academy, and also to assure that the total scientific community represented by the Academy be covered.

It was recommended to the Council that a single membership committee be established to combine the Business and Scientific Membership Committees now operating. Such a committee could, by separate sections, assume solicitation for the scientific as apart from the business memberships.

R. W. Engel, Chairman

REPORT OF THE INVESTMENT FUND TRUSTEES

General Endowment Account

	Book value	Market value
Amount invested in bonds—Government and Corporate	\$ 5,953.75	\$ 5,660.00
Amount invested in Preferred Stocks	1,790.85	1,368.00
Amount invested in Common Stocks	9,015.05	25,214.00
	\$16,759.65	\$32,242.00
Cash Principal	28.49	28.49
	\$16,788.14	\$32,270.49
Estimated annual income	\$ 1,181.00	
Cash income balance	164.13	

SPECIAL ACCOUNT

	Book Value	Market Value
Amount invested in Bonds Government	\$ 5,021.88	\$ 5,200.00

Amount invested in Stocks	1,752.50	1,720.00
	-----	-----
	\$ 6,774.38	\$ 6,920.00
Cash Principal	214.14	214.14
	-----	-----
	\$ 6,988.52	\$ 7,134.14
Estimated Annual Income	\$286.00	
Cash Income Balance	0	
Total book value and market value of investments as of March 8, 1961	\$23,776.56	\$39,404.63

Lloyd C. Bird, Chairman

FINANCIAL STATEMENT (Unofficial)

	Research Fund	AAAS Fund
On Hand, September, 1960	625.76	270.00
Income (S/A and Goethe)	593.65	260.00
Income (AAAS 1961 Grant)	-----	260.00
	-----	-----
Total	1,219.41	530.00
Research Grants	925.00	270.00
Horsley Award	150.00	
Annual Meeting (1961) (Est.)	50.00	-----
	-----	-----
Total	1,125.00	270.00
Balance, May, 1961	94.41	260.00

Jackson J. Taylor, Chairman

REPORT OF THE FINANCE COMMITTEE

The Finance Committee noted a drop of about 170 members during 1960, many of which are expected to be recovered after additional billings. An unexpended balance of over \$1,000.00, partly due to absence of printing the Academy Booklet this year, was discussed and a cushion of 2 years' income was suggested as desirable in the operation of the Academy.

The financial report follows.

VIRGINIA ACADEMY OF SCIENCE — 1960

INCOME 1960

INCOME 1960					ESTIMATED INCOME 1961	
<i>Dues</i>						
Regular Members	594	@	\$ 3.00	\$1,782.00	780	\$2,340.00
Contributing Members	177	@	5.00	885.00	180	900.00
Sustaining Members	50	@	10.00	500.00	50	500.00
Student Members	12	@	2.00	24.00	20	40.00
Business Members	17	@	100.00	1,700.00	20	2,000.00
Back Dues	—			111.00	300.00	
Total	850			\$5,002.00		\$6,080.00

Gifts

Philip Morris Tobacco Company	750.00	750.00
American Tobacco Company	200.00	200.00
Ralph Bargman	2.00	
W. Catsby Jones Award	10.00	10.00
Virginia Dairy Company	50.00	
	1,012.00	960.00

Miscellaneous

Sale of James River Basin	5 @ 3.50	17.50	35.00
Special Fund Income	411.34		400.00
Stock Dividends	105.40	534.24	105.00
			540.00

Meeting Income

Exhibits 16	1,170.00	1,125.00
Registration Fees	361.35	300.00
	1,531.35	1,425.00
		\$9,005.00
GRAND TOTAL		8,079.59

STATEMENT OF DISBURSEMENTS PERIOD ENDING
DECEMBER 31, 1960

	Approved Budget 1960	Dis- bursed 1960	Proposed Expenditures 1961
AAAS Travel Expenses	\$ 400.00	234.19	350.00
Dues Academy Conference	20.00	20.00	20.00
Catesby Jones Award	10.00	10.00	10.00
E. C. L. Miller Award	50.00	50.00	50.00
Junior Academy (including Philip-Morris Grant)	2,000.00	1,667.25	2,000.00
Science Talent Search	600.00	144.46	600.00
Annual Meeting Expenses	600.00	688.05	500.00
Audit—Tax Service	270.00	400.00	400.00
Bond Premium	12.50	12.50	12.50
Post Office Box Rent	64.00	32.00	32.00
Stationery, Supplies, etc.	200.00	56.85	200.00
Postage, Addressograph Service and Section Expense	300.00	423.43	450.00
Va. Journal of Science Subscription	26.00	26.00	26.00
Virginia Journal of Science	2,100.00	2,003.80	2,100.00
Miscellaneous	150.00	75.90	125.00
Charter Fee	5.00	5.00	5.00
Printing Academy Booklet	200.00		300.00
Printing Program	400.00	434.00	500.00
TOTALS	7,407.50	6,283.43	7,680.00
Unexpended Funds of Budget 1960		\$1,124.07	
Cash on hand 1 January 1961			\$2,736.43
<i>Research Account</i>			
Total Disbursements 1960		\$1,454.16	
Cash on hand 1 January 1960		625.76	

Boyd Harshbarger, Chairman

REPORT OF THE VIRGINIA JUNIOR ACADEMY OF SCIENCE

The V.J.A.S. membership includes 99 affiliated science clubs, more than 3000 members and 150 sponsors, and additional members of clubs and individuals are indirectly associated with the V.J.A.S.

Five Junior Science Days were held in cooperation with the College of William and Mary, University of Virginia, University of Richmond, Virginia Polytechnic Institute and Virginia State. At these meetings 2700 students and teachers, representing 191 schools were in attendance, and 405 exhibits from 45 clubs were displayed. Of these 75 were selected to be displayed at the Annual Meeting of the V.J.A.S. at Lexington.

The *Junior Science Bulletin*, financed by a \$300 contribution from the American Tobacco Company, was published twice and about 3000 copies were distributed to secondary schools throughout the state. The *Bulletin* was edited by Miss Susie V. Floyd.

The Annual Meeting of the V.J.A.S. was held May 10-11 at Lexington in conjunction with the Virginia Academy of Science. Dr. A. W. Kenney, Program Director for Advance Science Programs, National Science Foundation, was guest speaker at the Annual Awards Meeting. His subject was "What It Means to be a Scientist." Dr. Kendall W. King, of Virginia Polytechnic Institute, gave an illustrated lecture: "The Use of Algae in Space Flight" at the Thursday night meeting.

At the Annual Awards Hour the Philip Morris Achievement Awards, provided for by a grant of \$750 from Philip Morris, Inc. were presented to the first, second and third place exhibitors in five categories of endeavor.

W. W. Scott, Chairman

LIST OF AWARDS PRESENTED TO VJAS CLUBS and INDIVIDUALS
LEXINGTON, VA., 1961

PHILIP MORRIS ACHIEVEMENT AWARDS FOR SCIENCE EXHIBITS BIOLOGY

1st Place: William Siegfried, Gar-Field H. S., Woodbridge, Va. — "Conditioned Reflexes of Birds". 2nd Place: Sharon Lynn Bynaker, James Monroe H. S., Fredericksburg — Automaticity of the Heart of a Turtle and of a Frog". 3rd Place: Julia Meredith, Blacksburg H. S., Blacksburg — 'Ausotrophic Bacteria Mutants". Honorable Mention: Richard and Daniel Peacock, Fairfax H. S., Fairfax — "Population Study of a Mouse Eruption at Dulles Airport." Lawrence MacNamara, Francis Hammond H. S., Alexandria — "Plant Irradiation". Josephine A. Bowler, Booker T.

Washington H. S., Norfolk — "Does Thyroxin Affect the Development of the Chick Embryo?"

CHEMISTRY

1st Place: Russell Cook, J.E.B. Stuart H. S., Falls Church — "Centrifugally Accelerated Chromatography". 2nd Place: William Burtchaell, Fairfax H. S., Fairfax — "Determination of the Amino Acid Composition and Sequence in the Enzyme Glucosan Phosphorylase A." 3rd Place: Charles Baltimore, R. B. Worthy H. S., Saltville — "Spectrophometric Investigations of Copper Nickel Alloy". Honorable Mention: Michael Finegan, Fairfax H. S., Fairfax — "A Study of Chromic Acid Oxidation". Stephen Schechner, Norfolk Academy, Norfolk — "Extraction of Amino Acids from Human Hair". Archer Mitchell, Maggie Walker H. S., Richmond — "Electrophoresis of Abnormal Human Blood Sera".

PHYSICS

1st Place: John M. Cone, Jr., Francis C. Hammond H. S., Alexandria — "Droplets". 2nd Place: Michael Souders, McLean H. S., McLean — "Development of a Liquid Freon Bubble Chamber". 3rd Place: Peter H. Henry, Warwick H. S., Newport News — "Sun Seeking Systems".

MISCELLANEOUS

1st Place: David Leach, Bedford H. S., Bedford — "Photoluminescent Minerals". 2nd Place: Fred Horton, Wm. Fleming H. S., Roanoke — "Permutation Groups". 3rd Place: William Banks, Maggie L. Walker H. S., Richmond — "The Effect of Compazine on the Growth Rate of *Sarcina Lutea*". Honorable Mention: Carolyn Sanders, Hoffman Boston H. S., Arlington — "An Electronic Digital Computer". Douglas Van Houweling, Fairfax H. S., Fairfax — "The Electrical Catalysis of the CO Oxidation Reaction". Robert Weems, Patrick Henry H. S., Ashland — "The Strata of Westmoreland Cliffs". Stephen Barker, Gunston Jr. H. S., Arlington — "Swift River Power Project". Randall Zisler, Gunston Jr. H. S., Arlington — "From the Drafting Board to the Finished Project".

CLUBS

1st Place: Science Club, Newport News H. S., Newport News — "Dust". 2nd Place: Paige Wright and others, Lord Botetourt H. S., Daleville — "Pollution of the Mighty James". 3rd Place: Hampton Biology Club, Hampton H. S., Hampton — "The Harvester Ant of North America". Honorable Mention: James Manson and Shirley Trent, Mary M. Bethune H. S., Halifax — "The Uptake and Effect of Radioactive Mate-

terials in Plants". Biology Club, Fairfax H. S., Fairfax — "The Endocrinology of Rats". Gordon Carmichael and Robert Davis, Easton Jr. H. S., Roanoke — "The Analog Computer".

E.C.L. Miller Award (awarded to the outstanding VJAS affiliated Science Club) Lord Botetourt High School, Daleville, Va. Mr. George Stevens, Sponsor.

Major J. Catesby Jones Award William Siegfried, Gar-Field H. S., Woodbridge, Va.

Microbiology Award William Banks, Maggie L. Walker H. S., Richmond.

George Washington Memorial Engineering Award Peter H. Henry, Warwick High School, Newport News.

AAAS Membership Award Miss Priscilla Brown, Churchland High School, Portsmouth.

VAS Membership Award Douglas Scott, Bedford High School, Bedford.

Awards For Outstanding Research Papers 1st Place: Douglas E. Van Houweling, Fairfax H. S., Fairfax. 2nd Place: Miss Julia Meredith, Blacksburg H. S., Blacksburg. 3rd Place: Daniel Peacock, Fairfax H. S., Fairfax.

Teacher-Sponsor Scholarship Awards Mrs. Joseph J. Thaxton, Bedford H. S., Bedford. Mrs. Elizabeth Charlton, York High School, Yorktown. Alternates: Mr. Charles Holbert, Boiling Spring H. S., Covington. Mr. J. A. Kepcher, Norfolk Academy, Norfolk.

REPORT OF COMMITTEE ON VIRGINIA FLORA

Members of the Flora Committee are working on the flora of their sections of the State. Miss Artz is active in Shenandoah Valley and adjacent mountains. Dr. Freer continues to investigate the Flora of the Central Blue Ridge; Professor Shields is studying the ecology and Flora of the higher mountains of southwest Virginia, especially Bear Town Mountain in Russell Co. He has deposited specimens in the V. P. I. Herbarium. Dr. Crandall has given attention to local Flora; she and Dr. Chamberlain are studying the ecology and Flora of the Lee Experiment Forest in Buckingham Co.

Dr. H. A. Allard (U. S. Dept. Agr., retired) and Mr. E. C. Leonard (National Herbarium) have prepared a paper recording their investigation of the ecology and Flora of the Triassic area in the northern Piedmont of Virginia. It is scheduled for an early 1962 issue of *Castanea*. Fi-

nancial assistance (\$100) from Committee funds has been necessary to support the publication and to secure reprints.

Massey is compiling an annotated catalog of Virginia Flora. The habitat and known county records of each of more than 3,000 plant taxa will be recorded. A bibliography pertaining to Virginia Flora will be included. It will be a volume of some of some 300 pages.

A. B. Massey, Chairman

REPORT OF RESOURCE USE COMMITTEE

The committee focussed its attention on only one project this year: that of encouraging additional teaching of conservation in public schools. The work of the committee was in furtherance of the Conservation Short Courses, which are sponsored by the Virginia Resource Use Educational Council. A joint committee consisting of representatives of the Virginia Academy of Science, the Resource Use Educational Council, the Virginia Association of Soil Conservation Districts, and the Visginia Chapter of Isaac Walton League of America conducted four meetings to appraise the needs for additional teaching of conservation in public schools and to develop a plan to meet these needs. The last of these meetings was held with Dr. Woodrow Wilkerson, Superintendent of Public Instruction and his assistant. We feel that limited progress has been made in reaching our objective.

E. W. Mundie, Chairman

REPORT OF THE HISTORY OF SCIENCE COMMITTEE

A History of Science Committee was formed at the suggestion of the AAAS charged with the responsibility of producing a definitive history of the academy movement in Virginia and to record the efforts of scientific pioneers in Virginia and to indicate the scope and value of their contributions to science. This committee therefore has endeavored to collect materials concerning the present Virginia Academy, its origin, growth and contribution to science, and to collect materials about scientists of Virginia whose work needs to be recognized and remembered. A well documented bibliography on these subjects is most desirable.

First priority is given to gathering materials on the history of the Virginia Academy, including histories of all sections, lists of section and Academy officers, outstanding honors, awards won by members or other facts of interest.

The work on the scientists of Virginia is a vastly larger task, which

will require much devoted time and research. This part of the work program will begin when the Academy history is documented.

As of May, 1960 reports have been received from the Sections: Astronomy, Mathematics and Physics, Biology, Engineering, Science Teachers, Statistics. In May 1961 a report from the Section of Medical Science was received. Histories of the Virginia Institute for Scientific Research and the Virginia Junior Academy of Science are in preparation. The Committee hopes to find an author for the General History of the Academy, begun so well in the 1923-24 Proceedings by Dr. Ivey F. Lewis.

Isabel Boggs, Chairman

REPORT OF THE VIRGINIA JOURNAL OF SCIENCE

A financial statement of the *Virginia Journal of Science* prepared by an auditing committee of Frank Butler, Carl Allen and Boyd Harshbarger follows:

Receipts:

Academy subsidy, members	\$2,434.00
Advertising	364.20
Subscriptions	38.15
Transferred from savings	347.06
Extra pages	162.00
Programs	28.80
 Total	 \$3,874.21

Expenditures:

Printing	\$2,820.55
Postage and supplies	201.65
Travel	110.15
Freight, storage	55.25
Subscriptions	4.00
 Total	 \$3,191.60

Statement of cash account:

Cash in checking account Jan. 1, 1960	\$1,913.24
Total receipts	3,874.21
Total cash in checking account during 1960	5,787.45
Less total expenditures	3,191.60
Cash in checking account Dec. 13, 1960	2,595.85

REPORT OF THE LONG RANGE PLANNING COMMITTEE

During the year the Long Range Planning Committee has made several recommendations to the Academy Council. These are:

1. That the composition of the Council be changed to some extent by having the elected members nominated by the various sections. That there be one elected member on the Council from each Section, and that the term of office of such elected members be changed from five to three years. (The Subcommittee working out this plan was composed of Drs. Harshbarger, Hinton, Thompson, Hereford and Obenshain, Chairman.)
2. That a new committee be set up dealing with "The Teaching of Science in Virginia."
3. That another new committee be set up dealing with "The Natural Resources of Virginia."
4. That the Council study the problems of, and implement as soon as possible, the employing of a permanent Executive Secretary for the Virginia Academy of Science in order to press the needs of Science in Virginia.

These four recommendations were approved by the Council at its March 12, 1961 meeting, and steps are being taken toward securing possible Academy approval, where needed, and the implementing of each of these recommendations.

The Committee has continued to encourage progress on the projects having to do with "The Biology of the Dismal Swamp" and the development of "The Flora of Virginia."

W. S. Flory, Chairman

VISITING SCIENTISTS COMMITTEE — 1960-61

Thanks to the wonderful cooperation of scientists from Virginia and adjoining areas, the financial support of the National Science Foundation, and the excellent work of the committee representatives from the various colleges, it was possible to send 20 guest scientists for 2 days to 20 of our State colleges. Every report which we received regarding the program indicates that it was very successful.

J. C. Forbes, Chairman

H. W. K. Fitzroy, Administrator

REPORT OF THE RESEARCH COMMITTEE

Five requests totalling \$1,830.00 for research grants were received. The committee awarded only 4, totaling \$1,195.00, however, because of insufficient funds. In no case was the committee able to underwrite the entire cost of the proposed research, but all recipients indicated that other funds could be obtained so that all programs could be implemented. The four awards were:

Walter S. Flory, Blandy Experimental Farm, for use toward purchase of a photographic enlarger	\$300.00
Robert S. Young, Department of Geology, University of Virginia, for geological investigations in the Shenandoah Valley sulfide district	\$270.00
John E. White, Department of Mathematics, Bridgewater College, for use toward purchase of a computer	\$300.00
Ralph G. Steinhardt, Jr. Department of Chemistry, Hollins College, for research on some aspects of the theory of liquids.	\$325.00

Three research papers of unusually high caliber were submitted in competition for the J. Shelton Horsley award. The 1961 winner will be announced at the Friday meeting, May 12.

COUNCIL MEETING

May 13, 1961

President Hobbs opened Council Meeting at 10:00 A.M. with the following members present: W. B. Bell, W. S. Flory, Susie V. Floyd, J. C. Forbes, W. M. Hinton, Jackson Taylor, F. F. Smith, W. B. Wartman, Jr. and S. B. Williams.

Sectional representatives meeting with Council were: E. B. Brand, W. H. Brittingham, J. D. Calver, P. A. Hansen, Boyd Harshbarger, G. T. Miller, Jr., S. B. Row, and E. F. Turner, Jr.

Jackson Taylor reported for his special Committee on the Virginia Junior Academy of Science. After slight modification it was adopted on Taylor's motion. The recommendations adopted are as follows:

1. That the VJAS Exhibits program be continued. The VJAS committee is to be commended for its efforts to develop more effective means of recognizing and encouraging science talent in Virginia, and it is urged to continue these efforts.

2. That the plans submitted by the VJAS committee for dividing the state into seven or more geographical areas for the purpose of conducting preliminary judging of contestants be approved, such preliminary judging programs to be set up and conducted in accordance with the established policies of the Academy for its annual meetings.

3. That for each of these geographical areas the VJAS committee seek a host for such preliminary judging programs, and if unable to find a willing host, that the VJAS committee be authorized to set up the program for that area under the auspices of the Virginia Academy of Science, with the needed funds, not in excess of \$700 for all areas, being supplied by the Academy.

4. That the VJAS chairman be authorized, when requested, to make such re-assignments of contestants from one geographical area to another as he deems wise.

Dr. Flory presented a proposal from the Long Range Planning Committee for the simplification of the annual committee appointments. This would put all committees on a rotational basis where only one to six new appointments need be made by the incoming president annually for each committee. Since committees for 1961-63 are already selected, the plan would be implemented next year under Jackson Taylor. Council passed Dr. Bell's motion that the plan be adopted. This report without, as yet, a recommendation for the Committees on Resource Use and the new Committee on Natural Resources in Virginia is as follows:

Committee	Mem- bership Now	Suggested Number	Length of Tenure	Number of appoint- ments each year
Long Range Planing	19	18	3	6
Trustees	3	3	3	1
Research	5	5	5	1
Finance and Endowment	10	10	5	2
Junior Academy of Science	14	15	3	5
Visiting Scientists	9	9	3	3
Virginia Flora	7	9	3	3
Scholarship	9	9	3	3
Awards	3	3	3	1
Science Talent Search	6	6	3	2
Membership	8	12	3	4
Business Membership	8	12	3	4
Nominating	3	3	3	—
Resolutions	3	3	1	3
History of Science in Virginia	6	6	3	2
Science Teaching	—	9	3	3

Concerning the new Committee on the Teaching of Science (see minutes of March 12, 1961) a membership of 9 was recommended by Dr. Flory's Committee, each with a 3 year term so set as to rotate three each year, the persons selected to represent various fields of science, including science teachers. The function of this committee would be very broad and include such studies as H. S. certification requirements, science teaching loads, science teaching in the state, etc. Council passed Jackson Taylor's motion for its adoption.

Concerning funds for invited Section speakers, Flory reported "the unanimous opinion (of his Committee) was that the funds for such an activity were not available within the present Academy financial and budget structure, and that this was a problem that should be solved by the several sections."

Reporting further for his Committee Dr. Flory "recommended that the constitution and by-laws of the Academy be made more easily found and accessible by the two following methods: (1) that the annual Academy Booklet carry a notation to the place where the last complete printing of these articles can be found in the Journal, and (2) in The Proceedings for 1962 and thereafter in Issue No. 1 of The Journal — in each year divisible by 5 (1965, 1970, 1975, etc.) that the Constitution and By-Laws be published in complete form containing all changes and corrections and amendments made up to the said dates." Council approved Jackson Taylor's motion that this be implemented.

Mr. Wartman pointed out that the Trustees presently serve only in an advisory capacity and do not have the power to initiate or implement changes in investment or reinvestments of Academy funds. He recommended that the power over the Academy's investments be broadened from the current practice of involving the President and Treasurer's signatures to that of including the chairman of the Trustee Committee. He put this in the form of a motion which Council passed.

Dr. Forbes initiated considerable discussion concerning a visiting scientist's program for both high schools and colleges. Ultimately Dr. Bell moved that Hobbs and Forbes nominate a committee to develop a program for colleges and universities and another one for High schools. The motion passed.

Dr. Bell reported for his president's committee of three people, Flory, Jeffers and Harshbarger, who examined the reasons for delay in the issuance of the recent issues of the Journal. He read this report which indicated that the Journal would be on schedule by September 1, 1961.

President Hobbs read a letter from W. R. West and W. S. Wolcott listing the advantages if the Academy's annual meeting be held in large

centers and recommended Richmond, Tidewater and Roanoke. Council passed Bell's motion that this be referred to the Committee on Place of Meeting.

With the increasing length of time for which the place of meeting must be arranged in advance, President Hobbs appointed the committees, as President-elect for the 1963 and 1964 place of meetings. Thus the incoming president hereafter will arrange for the Academy meeting 4 years in advance.

President Hobbs read a letter from Dale Wolfe with respect to the use of AAAS funds assigned to the Academy. Council passed Dr. Bell's motion that the President reply with the advice of the Chairman of the Research Committee.

Council passed Jackson Taylor's motion "that Council express its grateful appreciation to Dr. Wilson Bell for his dedicated service to the Academy and commend him for the excellence, efficiency, and vision with which he has fulfilled the duties of his office."

The Treasurer asked permission to hold only 4 instead of 5 years of cancelled checks and bank statements. After some discussion Council passed a motion to this effect.

Adjournment.

Paul M. Paterson, Secretary

COUNCIL MEETING

May 11, 1961

President Bell called the meeting to order at 2:00 P.M. with the following present: Susie V. Floyd, J. C. Forbes, Boyd Harshbarger, S. M. Heflin, W. M. Hinton, H. H. Hobbs, Jr., G. W. Jeffers, H. G. M. Jopson, E. W. Ramsey, R. D. Ross, Mary H. Ross, W. W. Scott, F. F. Smith, J. J. Taylor, W. B. Wartman, Jr., and S. B. Williams.

The minutes of the last Council meeting had been distributed and Council moved their reading be dispensed.

Colonel Heflin, chairman of the Local Arrangements Committee, announced a historical tour of Lexington for the ladies Friday morning, and a parade of the Cadet Corp and a reception by Superintendent Shell Friday afternoon. In response, President Bell accepted these arrangements for the Academy with appreciation.

Dr. Scott reported for the Junior Academy Committee. The selection of exhibitors has been made regionally in the state except for the colored

schools, where all of their exhibits have been judged exclusively at the Virginia State College in Petersburg. The colored students objected to this arrangement and wish to exhibit regionally along with the other groups. After considerable discussion, Council passed a motion made by Dr. Flory requesting the President to appoint a committee to study the various facets in this matter and report back to Council at its meeting Saturday morning. President Bell appointed Walter Flory, William Scott and Jackson Taylor to this Committee with Taylor as chairman.

Dr. Scott reported (see minutes of March 12, 1961) that the 20th anniversary balls planned for the Junior Academy were cancelled because the colored students objected to the segregated arrangements, and that a scientific lecture had been substituted.

Dr. Scott further requested authorization for the severance of the relationship of the VJAS with Science Clubs of America, and that an affiliation fee be requested from the Science Clubs for participation in VJAS. Council passed Prof. Jackson Taylor's motion that such authorization be granted.

Dr. Ross reported for the Journal and Mrs. Ross, now Business Manager replacing Dr. Kral, gave the financial report where a balance of over \$350 was expected. The financial statement for 1960 had been audited by Frank Butler, Carl Allen, and Boyd Harshbarger and reported upon by the latter. Council passed Prof. Taylor's motion that the report be accepted with appreciation to the Auditing Committee. In the report, the Auditors questioned the great delays in getting out the issues of the Journal and recommended that Council give this matter their immediate attention. Dr. Ross, citing the findings of a conference of journal editors, reported, in part, that there is a national trend, in financing journals, to assess page charges and also to increase advertisements by forming journal pools where advertisement proceeds are divided proportionately according to the respective circulations. Council passed Dr. Stanley Williams' motion that the report be accepted.

Dr. Flory reported for the Long Range Planning Committee, the content of which is published elsewhere in this issue. Concerning the constitutional change to allow sectional representation on Council, (see minutes of March 12, 1961), the wording, as formulated by the LRPC was discussed and some changes made. Council adopted the revised wording on Dr. Hinton's motion so to do.

As the April issue of the Journal carrying the proposed constitutional change had not appeared, thus such a change could not be adopted, Mr. Foley Smith moved that the proposed change be presented to the Academy members at the Academy Conference, and that Sections be authorized

to elect representatives to serve with council subject to final constitutional approval next year. The motion was unanimously passed.

Treasurer Smith presented the Auditor's report prepared by J. Waddell Rison & Co. for the year 1960. Mr. Smith estimated the income for 1961 at \$9,000 and an expenditure of approximately \$7,600.

President Bell brought up the plans for combining the two Membership Committees, (See minutes of March 12, 1961). Council passed the motion made by Prof. Taylor that the two committees be combined under one chairman with two vice-chairmen to head up the two subcommittees, one on general membership and the other on business membership.

Dr. Forbes reported on the NSF sponsored program for Visiting Scientists to Virginia Colleges and Universities, and his report was approved by Council.

Dr. Hinton, reporting for the Awards Committee, recommended that the Distinguished Service Award be given to Mrs. Thelma Heatwole. This was approved by Council. The Awards Committee had been instructed by Council to procure a gavel to be presented at this Academy Assembly, (minutes of May 14, 1960), and Dr. Hinton reported one had been made. It was made of the wood of the dogwood tree (*Cornus florida* L.), the Virginia State Flower, and left in natural finish.

President Bell read an invitation from President Shannon of the University of Virginia to meet in 1964 at the University for the information of Council. The invitation will be presented to the Academy Assembly for acceptance.

Adjournment.

Paul M. Patterson, Secretary

MINUTES OF THE ANNUAL ASSEMBLY

May 12, 1961

President Bell called the meeting to order at 8:00 p.m. He presented General Shell, Superintendent of the Institute, who welcomed the Academy in a hospitable manner. President Bell then introduced Dr. Raymond L. Taylor, Associate Administrative Secretary of the A.A.A.S. who brought greetings to the Academy from the A.A.A.S.

Dr. Starling presented the resolutions formulated by the Resolutions Committee for Dr. Zoe Black who was not able to be present. They were approved and are published elsewhere in this issue.

Dr. Hinton, Chairman of the Awards Committee, presented to Dr. Bell

a gavel (See minutes of Council May 14, 1960 and May 11, 1961). It was appropriately made of the wood of dogwood, Virginia state flower. He then read the citation on and presented the distinguished Service Award to Mrs. Thelma Heatwole who for a decade has so wisely and efficiently led and built up the Virginia Junior Academy of Science.

President Bell then called on Dr. Scott, Chairman of the V.J.A.S. who reported the awards for the Junior Academy students, the several sectional awards, the A.A.A.S. award, and Teacher Sponsor Scholarships. These are published elsewhere in this issue. Dr. Scott also reported for Mr. Holmes where 40 awards were made in the Science Talent Search.

For the Research Committee, Professor Jackson Taylor, reported on the J. Shelton Horsley Award. The committee solicits judges who are not connected with the Academy and reside outside of Virginia. Two winning papers were selected, first and honorable mention. Thus two Horsley certificates were made and the Award of \$100 and Honorable mention of \$50 were pooled and divided equally. The papers are as follows:

A Study of the Recombination of Ions in Flames by Irving R. King, of Texaco Experiment Incorporated.

The Formation, Conditions and Structure of Thin Epitaxial Silver Films on Rocksalt by Billy W. Sloope and Calvin O. Tiller of the Virginia Institute for Scientific Research.

President Bell reported the invitation from President Shannon for the Academy to meet in May 1964 at the University of Virginia. The Academy gratefully accepted the invitation.

Dr. Forbes, reporting for the Nominating Committee, read the slate of officers for the coming year as follows:

President, Horton H. Hobbs, Jr.

President-Elect, Jackson J. Taylor

Secretary, Paul M. Patterson

Treasurer, Foley F. Smith

Assistant Secretary-Treasurer, William B. Wartman, Jr.

There were no nominations from the floor and Dr. Harshbarger moved the Secretary cast the ballot for the slate. Passed.

The sectional nominees to serve with Council were reported as follows: For 1 year terms:

Agricultural Sciences, W. H. Brittingham

Astronomy Mathematics and Physics, Edward F. Turner, Jr.

For two year terms:

Bacteriology, P. Arne Hansen

Chemistry, G. Tyler Miller, Jr.

Engineering, S. B. Row

For 3 year terms:

Geology, James L. Calver

Medical Sciences, Eugene D. Brand

Statistics, Boyd Harshbarger

President Bell then introduced Dr. Arthur Roe, Head, Planning Group, Office of Director, National Science Foundation, who spoke on Education for the Future.

He laid particular stress on the teacher, the student and the curriculum. He emphasized the innovations in the curriculum being developed in Physics at the Massachusetts Institute of Technology and other innovations being developed in Chemistry, Mathematics and Biology.

President Bell acknowledged Dr. Roe's address with appreciation and made appropriate remarks to those who had worked with him on Council and the Committees. He then installed the new officers and turned over the gravel to Dr. Hobbs. President Hobbs voiced his appreciation of the Academy's confidence in him and promised his best efforts during the ensuing year.

Adjournment.

Paul M. Patterson, Secretary

SCHOLARSHIP COMMITTEE

The scholarship committee of the Academy worked during the past year especially with high school teachers. Many of them in the State are now aware of scholarships available at least in Virginia institutions of higher learning. The bulletin of the State Department of Education entitled "*Financial Assistance to Attend Four-Year Colleges and Universities in Virginia*" is now available in most high school libraries. Also available is a U. S. Office of Education Bulletin, No. 18, entitled "*Financial Aid to College Students: Undergraduate*," a publication of the U. S. Departments of Health, Education, and Welfare. This invaluable directory, obtainable from the U. S. Government Printing Office, Washington 25, D. C., for a dollar, lists more than a thousand institutions by States and gives such important information about them as location, highest level of work offered, enrollment, charges for tuition, required

fees, board and room. This bulletin lists the number and average value of scholarships for freshmen; the number, average value and approximate range of all scholarships; the number and average value of loans; and the average compensation of teaching and research assistants and other employed students.

Members of the committee individually have endeavored to secure financial aid to attend college for only 21 high school seniors. It has been the high school teachers who have done the most in this respect for their better students. One area not sufficiently reached by the National and Virginia Science Talent Searches, the Virginia Junior Academy of Science and this committee has been the smaller country high schools where there must be scores of brilliant and needy seniors lacking guidance in securing college scholarships.

Sidney S. Negus

SECTION OF AGRICULTURAL SCIENCE

1. M. L. BOBB. Virginia Agricultural Experiment Station, Piedmont Fruit Research Laboratory. *Lesser Peach Tree Borer Control in Virginia*. The lesser peach tree borer, *Synanthedon pictipes* (G. & R.), has killed or caused serious injury to many peach trees in some of the more vigorous orchards of Virginia during recent years. Chemical control studies were made in replicated plots at Hampton during 1959 and 1960 with 7 insecticides. Parathion, thiodan and endrin gave the greatest reduction in infestation. Of these insecticides only parathion can be recommended for grower use at the present time since the other insecticides do not have clearance for use on peach fruits.

2. R. N. HOFMASTER. Eastern Shore Branch, Virginia Truck Experiment Station. *The Use of Living Insecticides to Control the Cabbage Looper*. Chemical insecticides have failed to give satisfactory control of the cabbage looper, *Trichoplusia ni* (Hbn.), on the Eastern Shore of Virginia during recent years. As a result, large acreages of cole crops have been rendered unfit for processing or fresh market consumption.

Recently, a naturally occurring nuclear polyhedrosis virus has become widespread throughout the area. In 1960 a joint mass rearing looper-virus infection program was conducted with the University of Maryland. Extracts were prepared from the diseased loopers and approximately 150 acres of broccoli, kale, and collards treated at weekly intervals. Application was by means of a high pressure sprayer at the rate of 5 diseased 5th instar loopers per acre on broccoli and 10 diseased 5th instar loopers per acre on kale and collards. Looper control was far superior to that obtained with insecticides at any time during the past 10 years. It is

felt that the future of cabbage looper control lies in the use of this virus and, possibly other biologicals, rather than insecticides.

3. J. M. STANLEY and U. F. EARP. Farm Electrification Branch, A.R.S., U.S.D.A. and Virginia Polytechnic Institute. *Equipment for Narrow Band Irradiation of Hornworm Moths.* Equipment has been developed for irradiating certain insects with narrow bands of radiant energy. A grating monochromator is used to diffract the energy from a hydrogen-arc lamp. This lamp has been used when dealing with the near ultraviolet (black light) region of the spectrum. An infrared telescope is used for observing the specimens. A photometer, using a 1P28 phototube as the sensing element, is the primary means for measuring energy levels. Environmental temperature has been controlled and equipment is being provided for controlling the humidity.

These facilities have been used for studying the spectral response of hornworm moths. Studies are planned for the near future in an effort to determine the same data for tobacco budworm moths. Other nocturnal insects are being considered for future study.

4. D. E. GREENWOOD. Virginia Truck Experiment Station. *Organic Chlorine Analyses of Toxaphene Residues on Leaf Crops.* The principles of total (organic) chlorine analysis and amperometric titration are discussed and applied to a study of the decline of toxaphene on three leaf crops. The specific data shown were submitted to the Food & Drug Administration for label acceptance of toxaphene on these crops. The interval between last application and harvest was shown to be affected by the formulation used and certain growth characteristics of the crop species treated.

5. M. H. LANCASTER and B. L. SAMUEL. Virginia Department of Agriculture. *The Application of Paper Chromatography to the Determination of Chlorinated Organic Pesticide Residues in Foods.* The paper chromatography method of Paul A. Mills (J. AOAC 42, 734, 1959) has been applied to the determination of chlorinated organic pesticide residues in foods. This application was described, showing small improvements to the method. Paper chromatography is a practical method for the determination of chlorinated organic pesticide residues. Its sensitivity is equal to or better than most other methods and its accuracy is adequate for residue work. It separates and identifies many of the chlorinated organic pesticides and can be applied to a wide variety of materials. Relatively inexpensive equipment is required and an inexperienced person will be able to do satisfactory work with a little training and two or three weeks' experience. A method was described for the determination of residues of Dowicide B (sodium 2,4,5-trichlorophenate) in or on vegetables. The method consists of acidification, and steam distillation

of the material from the vegetables. The distillate was extracted with petroleum ether, concentrated, and chromatographed on paper without further clean-up. Excellent results were achieved for all six of the vegetables worked with — tomatoes, peppers, sweet potatoes, cabbage, broccoli, and cauliflower.

6. E. L. WISMAN and R. W. ENGEL. Virginia Polytechnic Institute. *Nutritive Value of Tannery By-Product Meal for Chicks.* Approximately 400 tons of animal protein are produced annually as a by-product of the tanning industry in Virginia. The purpose of this study was to determine by 4-week chick growth assay if this material could be utilized in poultry rations as a source of protein. A meal was prepared from limed hide fleshings by washing to remove the lime and sulfides, hydrolyzing with mineral acids, and then cooking to obtain a homogeneous mixture. The solution was then neutralized and evaporated to a meal containing about 6% moisture after removal of most of the fat. A second meal was prepared by omitting the hydrolysis step and extracting the fat and moisture with acetone. Both meals contained 68% crude protein. Growth and feed efficiency data indicated that both tannery by-product meals could be used to replace up to $\frac{1}{4}$ of the soybean protein in a corn-soybean oil meal-type ration without depressing growth. In no instance did a ration containing the tannery by-product produce better growth than the soybean oil meal basal, indicating that it contained no unknown nutrient factor. Analysis of the tannery protein indicated that tryptophan was the first limiting essential amino acid; however, supplementation with L-tryptophan did not permit a greater level of the protein to be utilized.

7. G. M. CAHILLY, R. F. KELLY and R. F. MILLER. Virginia Polytechnic Institute. *The Effect of Dietary Lysine Level Upon the Subsequent Nutritive Value of Pork: Growth and Nitrogen Balance of Rats.* Hogs were fed a diet in which the biological value of the protein was experimentally altered by varying the level of lysine supplementation. Differences were noted in the muscles from these hogs with respect to total protein and lysine concentration which increased with increasing levels of lysine supplementation. Meat from these hogs was then fed to weanling rats with growth and nitrogen balance serving as criteria for comparison of protein nutrition. It was found that the over-all biological value of these meat proteins as measured by rat-growth and N-retention was not altered. Analysis of the serum protein fractions and muscle nitrogen content of the rats showed no differences. It is therefore concluded that feeding swine diets containing protein of good or poor quality results in no change in the nutritional value of the pork proteins as determined by the described methods.

8. C. S. HEGRE and M. D. LANE. Virginia Polytechnic Institute. *Studies on the Mechanism of Action of Mitochondrial Methylmalonyl Isomerase.* Methylmalonyl isomerase has been partially purified (about 23-fold) from bovine liver mitochondria. This purified enzyme catalyzes the isomerization of enzymatically synthesized $[1-^{14}\text{C}]$ -methylmalonyl-CoA and $[3-^{14}\text{C}]$ -methylmalonyl-CoA to $[1-^{14}\text{C}]$ -succinyl-CoA and $[4-^{14}\text{C}]$ -succinyl-CoA, respectively, as determined from degradation studies on the reaction products. These results are in agreement with the proposal of Eggerer, *et al.* that the isomerization involves rearrangement of the thioester carbonyl, and indicate that no CoA transfer is taking place prior to this rearrangement. A possible concerted mechanism for the intermolecular migration of the thioester carbonyl has been proposed. This mechanism would involve the condensation of two molecules of methylmalonyl-CoA to form a 6-membered cyclic transition state, with simultaneous rupture along a different plane to form two molecules of succinyl-CoA. Column-chromatographic evidence was also obtained which seems to support Mazumder's observation that two enzymatic activities are required for the isomerization of enzymatically synthesized methylmalonyl-CoA.

9. D. P. KOSOW and M. D. LANE. Virginia Polytechnic Institute. *Reversal of an Enzyme Lesion of Biotin Deficiency in Vivo and Vitro.* Lardy and Adler have demonstrated that biotin deficiency in the rat leads to a decreased ability of mitochondrial acetone powders to carboxylate propionate. This effect is due to the fact that biotin is a necessary co-factor in the carboxylation of propionyl-CoA.

We have observed that the propionyl carboxylase activity of mitochondrial acetone powders from biotin deficient rats can be increased three-fold by the intraperitoneal injection of biotin three hours before sacrificing the animals. The same magnitude of increase of the propionyl carboxylase activity of mitochondria lacetone powders can be observed when liver slices from biotin deficient rats are incubated with biotin in Krebs-Ringer phosphate under an atmosphere of 95% oxygen-5% carbon dioxide. In these experiments, it was observed that the propionyl carboxylase activity varied linearly with the biotin content of the mitochondrial acetone powders. An ammonium sulfate purified enzyme system has been prepared from biotin deficient whole liver acetone powder extracts which, in the presence of ATP, GSH, and biotin, can catalyze a 100% increase of its original propionyl carboxylase activity.

10. E. C. KU and K. W. KING. Virginia Agricultural Experiment Station. *Isotopic Nitrogen Studies on the Catabolism of Essential Amino Acids.* Complete nitrogen balance studies have been made of a mutant of *Escherichia coli* requiring leucine, methionine, and threonine under conditions of N-starvation and ample N supply. These data demonstrated

that methionine was used with 95-100% efficiency as a protein precursor. Leucine was used with 65% efficiency if ample ammonia was available, but the efficiency dropped to 35% in N-starvation. Threonine utilization fell from 12% efficiency to 8% efficiency when total-N was restricted. Data presented from experiments with N^{15} -labelled protein precursors indicated (a) no net synthesis of methionine, (b) extensive transfer of leucine-N to isoleucine, and (c) limited transfer of leucine-N to asparatate and valine. These observations were discussed in relation to their bearing on the nutritional interactions between non-essential nutrients and the essential amino acids.

11. HITOSHI MARUYAMA ad M. D. LANE. Virginia Polytechnic Institute. *Properties of Phosphoenolpyruvate Carboxylase Isolated from the Germinating Peanut.* Phosphoenolpyruvate carboxylase has been partially purified (50-fold) from extracts of germinating peanut cotyledons. The enzyme catalyzes the irreversible Mg^{++} -dependent carboxylation of phosphoenolpyruvate to form oxalacetate. Purified preparations of carboxylase are completely inactive in the absence of added sulfhydryl compounds, but are readily reactivated by glutathione addition. Carboxylase, active in the presence of small amounts of glutathione, is reversibly inhibited by p-hydroxymercuribenzoate. Co^{++} and Fe^{++} are 28 and 16 percent as effective, respectively, as stoichiometric amounts of Mg^{++} for the carboxylation reaction. High levels of the purified carboxylase failed to catalyze significant incorporation of Cl^{14} -bicarbonate into oxalacetate in the presence of oxalacetate, orthophosphate, Mg^{++} and glutathione; but in the absence of added phosphoenolpyruvate. When the enzymatic carboxylation of phosphoenolpyruvate is conducted in the presence of Cl^{14} -pyruvate, incorporation of Cl^{14} -activity into oxalacetate does not occur. In addition, high levels of the purified carboxylase failed to catalyze an exchange between Cl^{14} -pyruvate and oxalacetate in the absence of added phosphoenolpyruvate; but in the presence of added orthophosphate, Mg^{++} , and glutathione. The catalytic action of the carboxylase is not inhibited by avidin.

12. R. S. HO, J. P. FONTENOT, W. E. C. MOORE and K. W. KING. Virginia Agricultural Experiment Station. *Different Protein Levels in Purified Diets for Lambs* Two digestion and nitrogen balance trials were conducted with wether lambs to determine the optimum protein level in a purified ration for maximum cellulose digestibility. Each trial involved 8 wether lambs which were assigned to 4 treatment lots. Each ration consisted of purified cellulose, corn starch, corn sugar, corn oil, mineral mixture and vitamin A, D, and E. In addition, soy protein was added to the four rations so as to supply approximately 4, 8, 12 and 16% protein, respectively. When the dietary protein level increased from 4 to 8%, cellulose digestibility increased significantly from 53.3% to 72.9%. When the protein level was increased to 12 and 16%, cellulose

digestibility decreased significantly (compared to 8% ration). TDN values indicated that maximum efficiency of energy digestion was at the 8% protein level. Nitrogen retention increased significantly with each increase in dietary protein level. Observations on the rumen fluid of 3 lambs per treatment showed that average concentrations of N, NPN and $\text{NH}_3\text{-N}$ generally increased and pH values decreased slightly as dietary protein level increased. Levels of rumen sugars and volatile fatty acids were not markedly affected by protein level.

13. D. F. IBACH. E.R.S., U.S.D.A. *Use of Technical and Economic Data in Micro- and Macro-Analysis.* Definitions, work involved, and an example of results in a pilot study in the Georgia Piedmont using technical coefficients adapted for micro- and macro-analysis, are presented. Micro-analysis relates to economics of (1) factor-product relationships in the production process; or (2) resource combinations for farms such as optimum sizes and organizations for different incomes, or profit maximization solutions with land or capital restricted. Macro-analysis involves aggregate effects of general adoption of new farm technology. Projections are made of the number of farms and the acreages expected for operation at different levels of income and technology. Aggregate effects of changes on output, farm capitalization, and resource combinations can then be estimated. Meaningful macro-studies requires analysis of the competitive positions of areas. Macro-analysis is needed for representative major regions, using appropriate technical coefficients for each in programming models. Using locally developed coefficients, improved technology for corn would increase by 70 percent the fertilizer input optimum for limited capital, and would triple net returns per acre. Technical scientists and agricultural economists can use existing data and estimates in forward looking analyses pertaining to agricultural adjustment problems.

14. LILIA CESANA and R. C. CARTER. Virginia Polytechnic Institute. *Evaluation of the North Country Cheviot Breed of Sheep in Crosses for Lamb Productoin.* Rams of the North Country Cheviot (NCC) breed were compared with Hampshire, Suffolk and Dorset rams by crossing with grade Hampshire and crossbred Western ewes for market lamb production. Data were available for 3 years with observations from 350 lambs. The NCC progeny were compared with those of Hampshire rams in all 3 years and with those of Suffolks in 1958 and Dorsets in 1960. Differences in growth rates from birth to weaning of lambs by the 3 rams were not statistically significant. In 2 of the 3 years, the slaughter grades of lambs by the NCC rams were significantly lower ($P > .05$) than those of the other breeds averaging 2/3 grade lower in 1959 and 1/3 grade lower in 1960. Less information is available on the crossbred ewes and the data used comes from (NCC \times H), (NCC \times BL) (NCC \times NWBF) compared with (H \times H \times R); so far birth weight of lambs

and prolificacy appears to be about the same. The NCC cross ewes have averaged about a month later in date of lambing. In conclusion, there seems to be little advantage in using NCC for lamb production. Results from the productivity of NCC cross ewes are too meager as yet to warrant conclusion.

15. E. KREHBIEL and C. C. MAST; Virginia Agricultural Experiment Station. *The Inheritance of Horns in Dorset Sheep.* Data on 276 lambs born 1959-1961 in four purebred Dorset flocks from matings of scurred and polled rams to horned and first generation polled ewes were used in this study. It was difficult to classify young lambs accurately due to a difference in rate of development of scurrs and horns. Warwick and Dunkle (1939) postulated three alleles at one locus with sex-limited expression to explain the inheritance of horns in sheep. The Dorset breed would have the genotype (H'H') for horns, which is recessive to polled (H H) and dominant over the Merino or Rambouillet genotype (h h). Heterozygous (H' H') males are scurred but females may be polled or have very small scurrs. A chi-square fit of the data to Warwick's hypothesis resulted in a value of 4.71 with 17 degrees of freedom and a probability of 998 that the hypothesis fits the data. No polled homozygous (HH) ewes were available for this study. Matings with ewes of this genotype should be studied as well as more matings with heterozygous (H'H') ewes. It would also be interesting to know if there is a phenotypic difference between heterozygous (H'H') and the homozygous (HH) polled ewes.

16. T. J. MARLOWE and E. B. WILSON; Virginia Agricultural Experiment Station. *Some Factors That Influence the Sale Price of Purebred Hereford Calves in Southwest Virginia.* Factors studied included year, location, grade, dwarfism status, average daily gain (ADG), age, weight and index. Data included 201 bulls and 418 heifers sold at three locations in Southwest Virginia during 1955-59. Average price of all bulls and heifers was \$230.19 and \$151.70, respectively. All factors studied had a significant influence on sale price. Descending order of importance was year, dwarfism status, grade, location, weight, age and ADG for heifers. Sale price increased \$17.10 per grade point for bulls and \$12.57 for heifers. ADG was worth \$69.35 and \$10.00 per pound and weight \$13.31 and \$21.13 per cwt. for bulls and heifers, respectively, when considered together. By eliminating ADG weight increased to \$40.16 and \$28.54 per cwt. Buyers placed more emphasis on ADG in purchasing bulls, but more on weight of heifers. Age was important in bulls but not in heifers. When index was considered instead of ADG and grade, buyers paid \$2.55 and \$1.36 per index point for bulls and heifers, respectively. Buyers discriminated against pedigrees with known "carrier" or questionable animals with regard to dwarfism by paying \$58.46 more for bulls and \$47.12 more for heifers with clean pedi-

grees. Factors studied accounted for 75.65% and 66.29% of total variation in sale price of bulls and heifers, respectively.

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17. K. P. BOVARD and B. M. PRIODE; Beef Cattle Research Station, Front Royal. *Effects of Stage of Estrus, and Other Factors, Upon Conception Rate in Beef Cows Bred Artificially.* Approximately 460 beef cattle were bred artificially each year for two successive years during a 100-day breeding season. Total calf crops were approximately 50%. For three young bulls conception rates were 38% when used as yearlings and 57% as two-year-olds. Twelve older bulls used previously for natural service had conception rates of 78% from natural service and 50% when used artificially. Fresh semen showed a small but real advantage over frozen semen. Conception rates of cows bred twice during a single heat period were not different from those of cows bred once. Less difficulty was experienced with heat detection than has been reported by other workers. Cattle whose estrus was considered doubtful as judged by individual behavior and physical symptoms had per-service conception rates slightly less than cows believed to be definitely in estrus (23.2% vs. 27.6%).

18. MARION M. FARR, EVERETT E. WEHR and WILLIAM T. SHALKOP; Animal Disease and Parasite Research Division, A.R.S., U.S. D.A. *Pathogenicity of *Eimeria gallopavonis*.* *Eimeria gallopavonis*, isolated from turkeys sick with "ulcerative enteritis," has produced severe weight losses and from 10 to 100% mortality in experimentally infected pouls 3 to 6 weeks old. Heavily infected birds usually exhibited no symptoms until the end of the 5th day after inoculation, when they consumed less feed and began losing weight. Weight losses continued, and during the 7th and 8th days many of the birds discharged fluid, blood-tinged droppings. A few pouls died on the 6th day, but most of the deaths occurred on the 7th, 8th, and 9th days. Survivors usually began to eat normally

and to gain weight on the 8th day. Lesions were restricted to that part of the intestinal tract posterior to the yolk stalk. In severe infections, the entire mucosa of the lower small intestine, the rectum, and the proximal portions of the ceca contained marked inflammatory changes. Occasionally, small ribbon-like clots of blood were present in the ileum. Usually the lumina of the affected organs were filled with soft, white, cheesy material that consisted chiefly of coccidia in various stages of development under going caseation necrosis.

19. R. E. WEHR; Animal Disease and Parasite Division, A.R.S., U.S. D.A. *Studies on Leucocytozoon smithi in Turkeys with Observation on the Tissue Stages of the Parasite* In turkeys, *Leucocytozoon smithi* causes anorexia, droopiness, incoordination and, occasionally, convulsions that end in death. The acute stage usually lasts 2 to 3 days, after which the birds die or start to recover. Necropsy reveals emaciation, dehydration, congestion, and enlargement of the spleen and other organs. Recovered birds may carry the parasite in their blood. The intermediate host, *Simulium* or black fly, ingests the gametocytes of *L. smithi* while feeding on the blood of carrier birds. Gametocytes develop consecutively into gametes, zygotes, ookinets, and sporozoites. Infected flies transmit the sporozoites to turkeys by biting. Only hepatic schizonts of the parasite were found in turkeys in our studies. The megaloschizont stage, present in *L. simondi* of ducks, was not observed. Control of leucocytozoonosis in turkeys is largely a matter of controlling the *Simulium* fly, which lives along streams. Breeding places of the fly should be drained, when practical. Otherwise, larvicides should be applied to the streams. The use of drugs for destroying the parasite in birds has been disappointing. Effective prophylactic measures have been keeping the birds confined in rearing houses and using fine-meshed screens over the openings.

20. D. L. HALOCK; Virginia Agricultural Experiment Station. *Variability of Certain Soil and Plant Characteristics in a Uniformity Study with Virginia-Type Runner Peanuts.* An area 36 rows wide and 160 feet long was divided into 576 ten-foot single row plots to study variability of certain soil and plant characteristics in field grown peanuts treated similarly. The soil type was Woodstown loamy fine sand. The largest variance between any 2 adjacent plots within the test borders for each variable considered is given: Plant population—8; yield of fruit—3090 lbs./A.; contents of extra large, mature meat and shriveled seeds—21.7, 6.1, and 2.5%, respectively; soil pH—1.9; contents of soil P and exchangeable soil Ca, Mg and K—265, 900, 65, and 265 lbs./A.; contents of extra large, mature meat and shriveled seeds—21.7, 6.1, and 2.5%, respectively; soil pH—1.9; contents of soil P and exchangeable soil Ca, Mg and K—265, 900, 65, and 265 lbs./A., respectively; yield of peanut hay—4120 lbs./A.; and contents of Ca, Mg, K, and P in the peanut hay—1.8, 0.32, 1.0 and 0.25%, respectively.

21. W. W. MOSCHLER; Virginia Polytechnic Institute. *Mechanical Obliteration of Plot Boundaries in Soil Fertility Research.* Soil samples were taken from both sides of a line marking the boundary between limed and unlimed soil in two separate experiments. Lime was applied at the rate of 8 tons per acre 7 years prior to the sampling. In one experiment there was no mechanical tillage of the soil after the year of lime application. In the second experiment the soil was cultivated at least once each year and frequently twice each year. Conclusive proof that intermixing of soil across the plot boundaries had occurred was not possible due to the fact that no soil samples before liming were available for comparison. Soil pH values from both experiments strongly suggested, however, that intermixing has occurred to a maximum extent of about 4 feet on each side of the boundary. Thus, a zone approximately 8 feet wide has been blended to a detectable extent.

22. W. J. MEYER, D. L. KASTER and J. F. DERTING; Virginia Agricultural Experiment Station. *Field Observations on Fragipans in Soils of Prince William County, Virginia.* Fragipan horizons occur in all physiographic provinces of the County in soils from different parent materials, indicating a similarity in the processes involved. Fragipans are frequently associated with transported materials, as indicated by stone lines, by position of the soil in the landscape, by rocks not of residual origin, and by textural differences. Fragipan horizons occur in the transported material, the residual material, or both—depending largely upon the textures involved. Soils having fragipans do not show the characteristic gley condition above the fragipan; however, a light yellowish-brown color indicates restricted internal drainage. Clay flows, silt and clay coatings throughout fragipan, and diffuse lower boundaries indicate that water and fine soil material move into and through fragipan. A thin mantle of transported material on high ridge tops and broad upland flats is the remnant of a previous erosion cycle. Fragipans developed in soils in this position were formed during this older erosion cycle. Soils in colluvial positions appear to show various stages of fragipan development. Since these soils are still developing, it indicates the fragipans are forming during the present erosion cycle. This indicates that the development of fragipans is related to erosion cycles. A mechanism of formation is proposed.

23. C. R. DOWNING and S. L. FELTON; Virginia-Carolina Chemical Corporation. *Further Studies with Tributyl 2, 4-Dichlorobenzylphosphonium Chloride (Phosfon) as a Height-Retardant on Ornamentals.* Phosfon chemically identified as tributyl 2,4-dichlorobenzyl-phosphonium chloride was active in retarding a number of varieties of potted chrysanthemums at rates of 9.25, 0.5, 0.75 grams active ingredient per cubic foot of potting soil. The response of 21 varieties tested at these rates is discussed. Field trials of Phosfon on garden chrysanthemums showed that soil mix applica-

tions of the chemical were most effective. In decreasing order of effectiveness were soil drench applications, root dip treatments in the 0.05% dust and surface applications. Variations in response to Phosfon by a cross section of garden varieties is discussed. Growth habit and general appearance of most varieties was materially improved by Phosfon. Results with Phosfon on Petunia in both greenhouse and field tests are reviewed. Petunia was actively retarded by Phosfon, but it appears that sufficient Phosfon cannot be supplied in a single application to maintain optimum height retardation throughout the growing season without causing chlorosis under the methods described. The height retardation activity of Phosfon on potted Coleus and Salvia was also demonstrated.

24. G. C. SMART, Jr.; Virginia Agricultural Experiment Station. *Culture of the Soybean Cyst Nematode*. The soybean cyst nematode, *Heterodera glycines* Ichinohe can be cultured on the roots of soybean plants grown in various potting soils. However, when cysts of the nematode are separated from potting soils by the Cobb sieving and gravity method, debris consisting of undecomposed organic matter and weed seeds is also retained by the sieves. It is difficult and time consuming to accurately count or isolate cysts from the debris. In an attempt to eliminate the debris, quartzite sand (Q-Rok) and Attarlay, Attapulgus X-250, Kaolin Type 41, and Pike's Peak clays were tested alone and in various sand-clay proportions for the culture of cysts. These materials proved to be almost free of debris. The nematode reproduced in all the artificial potting soils tested, but a 90 percent sand-10 percent Kaolin Type clay (by weight) mixture was found to be the most satisfactory for good cyst production.

25. L. A. MARGOLENA; Agricultural Research Service, U.S.D.A. *Sudoriferous Glands of Sheep and Goats*. Comparative histologic studies of sudoriferous glands have been carried out on dorsal skin biopsies of Merino, Rabouillet, Hampshire, and Karakul sheep, and the common American, Toggenburg and Angora goats. Biopsies included young and mature specimen taken at different seasons and geographic locations, as well as pre-natal samples of Karakul sheep and of goats. No sudoriferous glands were encountered except those connected with the primary follicles, thus their numbers correspond to those of primary follicles. Irrespective of species and breed, the glands consist of a unicellular glandular epithelium resting on a more or less regular layer of Myoepithelial cells. This latter may be differentially stained and is particularly evident in glands with actively excreting cells. An acid fast material indicating the possible presence of mycolic acid was detected in certain glandular cells. A difference in the distribution of glands of wood sheep and goats was noted: those of sheep reach below the follicular level (Merino, Rabouillet, and Hampshire); whereas in goats, the sudoriferous glands cease growing lengthwise before they reach the bulb, and thus fail to penetrate

below the follicular level. In coarse-woolled sheep such as the Karakul, penetration tends to be intermediate. In the Hampshire, the sudoriferous glands spread out both between and under the follicles, while in the Merino types the glands form diverticulae and lobules of in a layer of their own.

SECTION OF ASTRONOMY, MATHEMATICS AND PHYSICS

At the business meeting of the section in May the following officers were elected for the coming year: Chairman, R. E. Garrett; Secretary, Billy W. Sloope; and Council Representative, Edward F. Turner, Jr. Your Section Editor's term extends another four years.

Dr. Robert E. Clark of the V. M. I. mathematics department has resigned to accept a position with Babcock and Wilcox of Lynchburg. Returning to that department from a leave of absence for graduate study will be Dr. Wilbur C. Whitten, Jr.

Dr. Edward F. Turner, Jr. has been named head of the Physics department at Washington and Lee following the retirement of Dr. R. W. Dickey. Dr. Dickey will continue to lecture in one course. Mr. William F. St. Clair, who has been visiting instructor at W & L for the past two years while on leave from Mississippi Southern College, will return home in the fall. Joining the department as Assistant Professor will be Dr. J. T. Ratchford, a recent graduate of the University of Virginia. Mr. William C. Keens, formerly of the V. M. I. physics department, will be Graduate Assistant at W & L while he begins the study of law.

D. Rae Carpenter, Jr., Section Editor

Physics Department, Virginia Military Institute

1. *L. A. SLUGA, R. D. BOYLE, and P. E. HEXNER*; University of Virginia. *Protein Molecular Weights.* The magnetically supported ultracentrifuge is shown to be an excellent tool for the precise determination of protein molecular weights. A brief description of the ultracentrifuge including the magnetic support system, a new electric drive system, temperature control, vacuum system, optical system, rotor and cells is given. Precise temperature control and extremely stable rotation of the magnetically supported rotor permit a degree of precision otherwise unattainable. The sedimentation equilibrium method of molecular weight determination is used because its firm thermodynamic foundation and its independence of molecular shape make it very reliable. Data and results: Ribonuclease was investigated for calibration purposes and repeated experiments gave an aver-

age weight of 13,653 which is in good agreement with the amino acid analysis of 13,683. Insulin shows an aggregation at higher concentrations, its weight-average molecular weight varying from 11,427 (the dimer) to 17,841 as concentration was increased from .1521% to .4111%. Preliminary results on Fraction I of green leaves of beans shows a molecular weight of approximately 275,000.

2. J. W. BEAMS. University of Virginia. *The Measurement of Very Low Air Pressures.* The deceleration of a magnetically suspended freely rotating sphere has been measured at various air pressures over the range from 10^{-3} to 10^{-8} torr. The results can be accounted for by the assumption that all of the friction on the sphere was due to air friction alone. The measured decelerations were in excellent agreement with the relation

$$\log_e \frac{N}{N_0} = \frac{-5p}{rd} \left(\frac{M}{2\pi RT} \right)^{1/2} (t - t_0)$$

Where N_0 is the rotor frequency at time t_0 and N the rotor frequency at time t , p is the pressure in dynes per cm^2 , r the radius of the sphere in cm , d the density of the sphere, M the molecular weight of the gas surrounding the rotor, R the gas constant and T the absolute temperature. In deriving the above equation it is assumed that the mean free path of the gas is long in comparison to the diameter of the vacuum chamber and that molecules which strike a moving polycrystalline surface emerge from the surface with a random velocity distribution with respect to the moving surface. The experiments, when continued to lower pressure, may be able to set an upper limit to possible gravitational radiation.

3. FITZ, H. C. JR. University of Virginia. *Structure and Mechanical Properties of Thin Gold Films.* Former work done on thin metal films at the University of Virginia by J. W. Beams and his students is reviewed. This experiment employed the bulge technique to determine mechanical properties of polycrystalline gold films grown by evaporation; a direct dependence of the ultimate tensile stress on the rate of film growth has been observed. Electron micrographs show variations in film structure as a function of rate of growth and partly explain the observed mechanical properties.

4. BEAMS, J. W., SPITZER, D. M., JR., and J. P. WADE, JR. University of Virginia. *Rotational Energy Losses of an Ultracentrifuge.* The authors investigated energy losses of spherical rotors spinning at high rotational speeds, while supported in the magnetic field of an ultracentrifuge. With the reduction of the deceleration of a rotor to a rate equal to or lower than that describing the energy loss to molecular collisions at an equivalent pressure of 10^{-10} mm. Hg, a testing instrument is available for

studying one of the current gravitational field theories. The high vacuum is obtained by immersion of a part of the system in liquid helium.

5. *J. S. HARNE and T. E. GILMER, JR.* Virginia Polytechnic Institute. *Infrared Absorption in Neutron Irradiated Silicon.* The infrared absorption of neutron irradiated silicon was compared with that of non-irradiated silicon at room and liquid nitrogen temperatures. Irradiated samples were 0.082 inch and 0.197 inch in thickness. The un-irradiated sample was 0.081 in thickness. The samples were irradiated with 10^{-19} fast neutrons/cm². The samples were mounted in a low temperature optical cell for all absorption measurements. It was found that instead of the 1.75 micron absorption band that has been mentioned in numerous papers, transmission was completely cut off below 2.5 microns at room temperature and about 1.8 microns at liquid nitrogen temperature. A weak absorption band was noted at 4.4 microns for all three samples at liquid nitrogen temperature and for the two irradiated samples at room temperature. Absorption due to free carriers decreased at the longer wavelengths (10-15 microns) with irradiation and cooling as was expected from past experiments. The resistivity of one sample was found to increase from an initial value of 88 ohm-cm to 1.9×10^3 ohm-cm upon irradiation.

6. *TURNER, EDWARD F., JR.* Washington & Lee University. *A Demonstration Field Tank for Triodes.* A electrolytic field tank in which the electric field for various triode configurations can be explored is demonstrated. The measured value of the amplification factor of a triode may be compared with the theoretical value obtained from physical dimensions. The apparatus is also suitable for an experiment in the elementary electronics course.

7. *BUSHNELL, D. L.* Virginia Polytechnic Innstitute. *A Monte Carlo Calculation of the Resonance Escape Probability of Thorium.* The Monte Carlo method of sampling a distribution by selecting random numbers is used to decide the fate of a neutron at each of its collisions with moderator or absorber atoms while it slows down in a homogeneous medium (aqueous solution of $\text{Th}(\text{NO}_3)_4$). A statistical weight for the neutron is carried along through its history giving a measure of the amount of absorption it suffered. The resonance escape probability for the thorium solution is computed by the ratio of the total weight surviving to below 10 ev to weight entering the resonance region. Single level Breit-Wigner Doppler Broadened formulae are used to represent the resonances. Throughout the range of possible thorium number densities for this solution, the resonance escape probability for an infinite system is given by $P=1-0.367 m_{\text{th}}$. The origin neutrons come from a H^2 (H^2, m) He^3 reaction. It is found that theoretical expressions for the resonance escape employing the assumption of

narrow resonances is adequate for the infinite geometry, however, the Monte Carlo provides a method for watching the leakage effect due to finite geometry. Experiments are being designed as a further check on the method and its results.

8. BOWLES, ROWLAND L. University of Richmond. *Two Component Scintillation Decay of Stilbene.* Since a definite difference exists in the light pulse emitted by an organic phosphor when excited by particles of different specific ionization, it was decided to develop a mathematical model which would predict the observed pulse shape differences and thus provide information for the design of a circuit which will efficiently discriminate between neutron and gamma-rays. (Stilbene was used as the scintillator in this model). Hence, it was decided to study the pulse shape as a function of time, with stilbene used as the scintillator. The charge pulse appearing at the anode of the photo-multiplier is determined analytically. Using the assumed model of K exponential components for scintillation decay a method is devised which enables one to calculate the decay times of the components involved. As a result of this model the percentage light carried by each component is determined. Comparison is made of the analytical and experimental pulse shapes. The experimental results were obtained by using the assumed model as a guide. An expression is given for a dimensionless variable which completely describes the pulse shape. The pulse shapes were observed under neutron and gamma-ray excitation making possible charge pulse shapes for particles of different specific ionization.

9. STEWART, JOHN W. University of Virginia. *Compressibilities and Phase Transitions in Solid SiH₄, SF₆, HCl and HBr at High Pressures.* Data have been obtained for these four substances at various temperatures, and at pressures up to 20,000 kg/cm². All except HBr showed a rather sharp first order phase transition which could be observed as a function of temperature and pressure. The expected second order transitions in HBr were not observed; perhaps they were "smeared out" by impurities in the samples. The data are summarized in the following table:

Substance	Temp. °K	Molar Vol. cm ³ /mole	$\frac{-V}{V_0}$	$\frac{-1}{V_0} \left(\frac{V}{P} \right) T$	P = 0 cm ² /kg	Melting Point x 10 ⁻⁵ °K	Transit- ions at P = 0 °K	Observed dP/dT for transition line at P = 0 kg/cm ² /°K
HCl	130	25.3	0.24	3.6	159	98		440
HBr	150	31.7	0.24	3.6	186	90, 114, 117	not observed	
SiH ₄	80	—	0.30	3.1	89	63		91
SF ₆	182	57.3	0.24	2.9	223	94		83

10. KING, I. R. Texaco Experiment, Inc. *Recombination of Ions in Flames.* The abnormally high concentration of ions created in the combustion zone of most flames has mystified scientists for many years. Although considerable effort has been devoted to the problem, the type of ions formed and the mechanism by which they are formed remains a mystery even today. Closely associated with the problem of ion formation is that of ion recombination—that is, how do the ions recombine once they have been formed? It is this later problem with which the present paper is concerned. The paper describes a technique for measuring recombination rates in flames and presents some results showing the effect of temperature, pressure, and the presence of electronegative gases on recombination. Results indicate recombination in flames is a second order process occurring by either a third-body or a dissociative process, and that the process takes place between two ions rather than between an electron and an ion. Recombination rates vary little from one hydrocarbon flame to another, but may be influenced appreciably by the introduction of trace amounts of electronegative gases. Results of the study are accompanied with predictions based on present day theories.

11. CARPENTER, D. RAE, JR. Virginia Military Institute. *Heat Flow Problems in Rods of Varying Cross Sections.* A study of the variation of temperature vs. time at the end of conductors of various cross section is reported. The conductors studied were of three types: 1. Uniform cross section—right circular cylinders, 2. Uniformly decreasing cross section—right circular cones, and 3. Exponentially decreasing cross section. Rods initially at a uniform ambient have applied to one end a fixed high temperature. The temperature of the other end has been obtained by electrical analog and the results tested experimentally and, in type 1 above, theoretically as a function of time and other variables. Work done under contract for Diamond Ordnance Fuze Laboratories, Washington, D. C.

12. WILLIAMS, C. E. AND J. W. BEAMS. University of Virginia. *Molecular Pumps for Producing High Vacua.* In order to produce the lowest pressure in a vacuum system it is important to bake out the system including the final stages of the pump. Completely bakeable molecular pumps have been developed. The steel rotars are magnetically suspended inside of vacuum chambers made of non-ferromagnetic materials such as glass or stainless steel. They are spun by rotating magnetic fields produced by field coils located outside the chamber. The stators made are of non-ferromagnetic material which may be degassed by baking. Operational data will be given including ratios of the pressures on the high to the low sides of the pump and pumping speeds as a function of the clearance between rotor and stator depth and shapes of grooves and the peripheral speed of the rotor. Pressure ratios of over 10⁴ and pumping speeds of a few liters/sec are not difficult to obtain. The fore pumping system con-

sists of the usual rotary oil pump, diffusion pump liquid nitrogen trap series arrangement. Supported by Navy Bureau of Weapons and Army Office of Ordnance Research.

13. WALKER, W. A. AND W. D. WHITEHEAD. University of Virginia. *Measurement of the Magnetic Field in the Synchrotron.* The University of Virginia 70 Mev synchrotron operates as a betatron during part of each cycle. To improve beam intensity, the electron capture mechanism of the betatron is being studied. As a part of this study, the structure of the dynamic magnetic field has been investigated by a coincidence method employing peaking stripes. Describing the radial dependence of the field by: $B = B_0 \left(\frac{R_0}{R} \right)^n$, (n) is found to be 0.7. The useable portion of the magnetic field is narrower than had been anticipated. The field is not independent of azimuth, but contains a sizeable azimuthal second harmonic component. From these results, corrections for the field will be devised.

14. ROGERS, J. T. AND C. D. BOND. Virginia Polytechnic Institute. *A Neutron Polarimeter Employing a Liquid Helium Scintillant.* The construction of a neutron polarimeter employing a liquid helium scintillant is under investigation. Polarization of the incident neutron beam would be ascertained by measuring the left-right asymmetry in the usual fashion. Coincidence counting between helium scintillations and stilbene detection of scattered neutrons in this design should reduce the statistical error normally encountered in this type of polarization measurement. The scintillation of liquid helium when exposed to a Plutonium-Beryllium neutron source was observed. The wavelength of the scintillations was shifted with sodium salicylate and p-quarterphenyl and then detected by a Dumont 6292 photomultiplier tube. The signal to noise ratio was approximately one.

15. FURR, A. KEITH. Virginia Polytechnic Institute. *P-Wave Strength Functions of Elements Near A=100.* An attempt has been made to determine the average nuclear resonance parameters and for nuclei near atomic weight 100. This was done by using B^{10} filters in a neutron beam extracted from the ORNL Graphite Reactor and measuring the activity induced in the samples. By comparing the activity as a function of boron thickness with theoretical curves supplied by the math panel at ORNL it is possible to determine the parameters mentioned above. The nuclei that were investigated were Zr^{96} , Mo^{98} , Mo^{100} , Rh^{103} , Ag^{107} , In^{115} , I^{127} , Pt^{198} and Au^{197} . Parameters have been obtained for two of these, In^{115} and I^{127} . The last of the parameters mentioned above is the one in which we are most interested. The values obtained for this parameter for the two nuclei are 1.3×10^{-4} and 0.74×10^{-4} respectively.

16. SLOOPE, BILLY W. AND CALVIN O. TILLER. Virginia Institute for Scientific Research. *Formation Conditions and Structure of Thin Epitaxial Silver Films on Rocksalt.* A comprehensive experimental investigation of the effects of conditions of formation on the structural characteristics of this single-crystal Ag films vapor deposited onto NaCl single crystals is reported. Formation conditions include: preannealing heat treatment of the substrate, postheat treatment of film and substrate, substrate temperature during deposition, and rate of deposition. It is shown that an epitaxial temperature as such does not exist and that the minimum deposition temperature for the formation of single-crystal films is rate dependent. Crystalline structure, continuity, and stacking faults density are related to the rate of deposition, deposition temperature, and thickness.

17. SHIMURA, KAZUTERU AND T. E. LEINHARDT. Virginia Polytechnic Institute. *Temperature Dependence of the Electrical Resistance and Crystal Structure of Metallic Cerium.* A study to establish the relationship between the temperature dependent D.C. resistance and the crystal structure of high purity Cerium was carried out. Low temperature X-ray diffraction techniques were used to determine the crystal structure, while an ordinary potentiometric method was used for the measurement of the electrical resistance of the specimen. A liquid nitrogen cryostat, suitable for use with a G-E XRD-5 Diffractometer unit was constructed and successfully operated. Experimental results showed a definite correlation between the two properties mentioned above. A specimen which initially was one hundred per cent F.C.C. reached equilibrium in both the electrical resistance and crystal structure after two thermal cycles between room temperature and liquid air temperature. In equilibrium the specimen consisted of 77 per cent F.C.C. and 23 per cent H.C.P. at room temperature, and 55 per cent F.C.C. and 45 per cent H.C.P. at liquid air temperature. This research was supported in part by the Atomic Energy Commission.

18. SEVIER, J. R., JR. College of William and Mary. *Direct Conversion of Heat to Electrical Energy Using Magneto Hydrodynamic Principles.* When a conducting gas is passed through a magnetic field, then an EMF is induced in the gas and a current flows in a direction perpendicular to both the flow direction and to the magnetic field. If electrodes are provided and connected to a load, then electrical power may be extracted from the flow. Such a device, called the magneto hydrodynamic generator, is discussed. The MHD generator is contrasted to conventional means of generating electrical power, and is shown to be potentially a more efficient device. Certain disadvantages are mentioned, such as the necessity of high temperature operation, even on the exhaust side of the generator. Sources of MHD generator losses are discussed including eddy currents, Hall effects,

and ion slip effects. Finally, an experimental MHD generator is described and the anticipated tests are discussed.

19. SPENCER, PAUL R. NASA Langley Research Center. *Angle Sensitivity of a Silicon Cell Solar Sensor.* The solar sensor described in this talk may be used for a variety of space operations requiring solar orientation. The use of silicon solar cells as the sensing elements provides the sensor with sufficient capability to withstand the hazards of a space environment. A method of arranging the cells into a sensor consists simply of mounting them at a large angle to the base. The use of an opaque shield placed between the cells and perpendicular to the base enhances the small-angle sensitivity while adding slightly to the bulk of the sensor. The difference in illumination of these cells as the result of an oblique incidence of the light rays from the reference source causes an electrical error signal which, when used in a battery-bridge circuit, requires a minimum of electrical processing for use in a space-vehicle orientation control system. An experimental version of the solar sensor has been constructed to obtain angle sensitivity data. Tests on this sensor have produced an angle sensitivity of 1.2 millivolts per second of arc with a load resistance of 1,000 ohms using as a reference light source an aircraft landing lamp delivering 1200 foot-candles to the sensor.

SECTION OF BACTERIOLOGY

1. BRUCE L. FARISS. University of Virginia School of Medicine. *Studies on the Passive Transfer of an Accelerated Macrophage Response to BCG in the Rabbit.* A form of hypersensitivity has been transferred which has some of the characteristics of delayed hypersensitivity of the tuberculin type. An indurated reaction in the skin to the whole organism, BCG, has been transferred by the use of serum from vaccinated-challenged or hyperimmune rabbits to normal rabbits. This reaction is characterized by induration and minimal erythema at the injection site of the BCG skin test reaction site in 24 to 96 hours. Microscopic examination of the BCG skin test site shows localization of the BCG, minimal necrosis and the accumulation of macrophages in the rabbit receiving hyperimmune serum.

2. WILLIAM B. HUNT, JR. University of Virginia School of Medicine. *Studies on Antibody Production in Rabbit Lung.* Rabbits were injected subcutaneously with bovine serum albumin, Falba and Bayol F (BSA-adjuvant) and subsequently re-injected intravenously with 5 mg BSA in saline after a three week interval. Another group of rabbits were injected intravenously with 10 mg alum precipitated BSA (AP-BSA) every

3-5 days for one month. Lung explants from BSA adjuvant rabbits placed in an *in vitro culture system* (Stavitsky; *J. Immunol.*, 75:214, 1955) produced measurable antibody titers (Boyden Tanned Cell Hemagglutination; *J. Exp. Med.*, 93:107, 1951). Spleen explants of BSA-adjuvant rabbits produced titers 8 to 16 times those of the lung explants. Lung explants of AP-BSA rabbits equalled spleen explants in antibody production. The transfer of 24-48 million aleveolar macrophages from AP-BSA animals to normal rabbits did not result in measurable antibody titers in the recipient rabbit. The relationship of the observed antibody production of lung explants to the granuloma formation and lymphoid infiltration which occurs will be discussed.

3. EFTHYMION, CONSTANTINE AND P. ARNE HANSEN. University of Maryland. *The Serology of Lactobacillus acidophilus*. A representative collection of *Lactobacillus acidophilus* strains, all classified by physiological criteria according to Orla-Jensen, Tittsler and Rogosa was analyzed by the agglutinin adsorption method. The species is not serologically homogeneous and there is no common antigen shared by all strains. Several antigenic components could be recognized. The Williams-Orland antigens A, B, D, E, F, H, were found in various combinations in part of the strains, also the L antigen described by Miller and Hansen in some cultures of *Lactobacillus lactis*, but never the K antigen. Together with these, additional antigens (N, O, P, Q, R, S, and T), not mentioned hitherto were disclosed. One type of *L. acidophilus* strains was characterized by one antigen M, which never occurred in combinations with any of the other antigens mentioned. The fluorescent antibody technic yielded results agreeing with the data of tube agglutination. It is recommended that the type culture for the species shall be a strain having the M antigen and, of course, the normal physiological characteristics mentioned above.

4. HALL, CHARLES T. AND P. ARNE HANSEN. University of Maryland. *Staining of Animal Tissues with Fluorochromes*. Aluminum chelates of a number of 2,2'-dihydroxy azo dyes were studied as counterstains for use in conjunction with fluorescein labeled antibodies. The dyes were prepared in concentrations of 2.8×10^{-6} mole per ml of N,N-dimethylformamide and chelated by addition of an excess aluminum chloride. The counterstains were incorporated into the conventional fluorescent slide preparations in buffered glycerol, pH 7.2. Immunochemically stained, mixed bacterial slide preparations were successfully counterstained by one chelated azo dye, 2-hydroxy-1 (2-hydroxy-5-chlorophenylazo) naphthalene only. Moderate to intense fluorescent reactions were readily detectable, although low order (1+) fluorescence of the immune label was masked by this counterstain. Immunochemically stained flagella exhibited the characteristic yellow-green fluorescence of the immune label. All the chelated azo dyes, Acid Alizarine Garnet; Pontachrome Violet;

Pontachrome Blue Black; Erochrome Black; Diamond Red; and 2-hydroxy-1 (2-hydroxy-5-chlorophenylazo) — naphthalene successfully counterstained formalin fixed tissue sections containing immunochemically stained, infective organisms. The bacteria were observed with no difficulty against the contrasting color of the tissue.

5. BELL, JAMES B., University of Virginia. *Toxoplasma gondii* Infection of Tissue Culture Cells and Animals. Tissue cultures of HeLa cells and "epithelial-like" cells derived from human tonsils were found to be suitable for the "storage" of *Toxoplasma gondii*. Tissue cultures infected with the organism and nourished with Growth Medium contained viable *T. gondii* after 41 days when they were incubated at 26°-28°C without a change of media. After 80 days of incubation viable *T. gondii* could also be demonstrated in the medium of tissue cultures maintained at 26°-28°C with a change of media every 21 days. No change in pathogenicity for mice was observed in organisms stored by these methods and peritoneal fluid from mice infected with these organisms was suitable for use in the Sabin-Feldman Dye Test.

6. VOLK, WESLEYA., University of Virginia. *D-arabinose metabolism in Propionibacterium pentosaceum*. A D-arabinokinase has been purified and characterized from *P. pentosaceum*. This kinase phosphorylates D-arabinose in the 5 position to form D-arabinose-5-phosphate. Mg^{++} is required, but can be replaced by Mn^{++} . GTP is equally as effective as ATP as a phosphate donor. ITP, UTP, and CTP can also function in this phosphorylation, but to a lesser extent than ATP and GTP. Neither D-glucose, D-mannose, D-galactose, D-fructose, L-arabinose, nor D-xylose are phosphorylated. The final enzyme, purified 113 fold, still phosphorylated D-ribose, D-ribulose, and L-ribulose; however, since the phosphorylation of these latter 3 sugars is not inhibited by the addition of D-arabinose, it is believed that their phosphorylation is a result of contaminating enzymes and not due to D-arabinokinase. K_m values for D-arabinokinase are as follows: D-arabinose, 1.2×10^{-3} ; ATP, 8.3×10^{-4} ; and Mg^{++} 2.9×10^{-3} .

SECTION OF BIOLOGY

1. MURRAY, JOSEPH J. AND ROBERT O. PAXTON, Lexington, Virginia. *Southward Dispersal into Virginia of the Evening Grosbeak*. The southward dispersal of the Evening Grosbeak, *Hesperiphona vespertina* (Cooper), is studied, with special reference to its spread in Virginia. Occurrences, particularly for the peak years of 1951-1952, and 1959-1960, are summarized from references in *The Raven*, journal of the Virginia Society

of Ornithology. Conjecture as to the causal factors in the southward dispersal of this boreal bird are advanced.

2. LENA ARTZ, Waterlick, Virginia. *Twelve Native Plants from Shenandoah and Frederick Counties, Virginia.* Brief notes of interest, accompanied by slides, will be given on twelve plants that are not abundant in Shenandoah and Frederick Counties, Virginia. Among the twelve will be a report on *Fraxinus nigra* Marsh. This northern species of ash was reported by Asa Gray from Virginia. However, Gray's station for it remains unknown. The only known station in Virginia for this ash is in Shenandoah County, Virginia.

3. R. O. FLAGG, Blandy Experimental Farm. *Derivations of the yellow Cooperias.* Morphological, cytological, ecological and distributional studies support the hypothesis that *Cooperia smallii* ($2n = 53, 54, 58, 70, 72$) and *C. Jonesii* ($2n = 48, 72$) originated as hybrids between *C. drummondii* ($2n=48, 56, 58, 60, 68, 72,$) and *Zephyranthes pulchella* ($2n=48$). The predominant form of *C. smallii* has a somatic complement of 54 chromosomes and apparently is a cross between *Z. pulchella* and a form of *C. drummondii* with $2n=60$. A narrowly distributed *Zephyranthes* taxon—intermediate between *Z. pulchella* and *C. jonesii*—along with *C. jonesii* and certain forms of *C. drummondii* possess a distinctive subtelocentric chromosome.

4. GRAZIANI JOANNE, Randolph-Macon Woman's College. *Anaphylaxis in Young Chickens.* Studies were undertaken in order to obtain information on the conditions necessary to produce fatal anaphylactic shock in two-to-six week old chickens. The antigen employed was Bovine Serum Albumin and the interval between sensitizing and challenging dose (induction period) was six days. The data obtained suggest a possible correlation between the age of the chicken, the sensitizing dose of the antigen, and the severity of the resultant shock.

5. FLORY, W. S. AND R. O. FLAGG. Blandy Experimental Farm, University of Virginia. *Chromosomes and Generic Status of Pyrolirion.* Somatic chromosome numbers in *Pyrolirion* are: *P. flammeum* — 35; *P. aureum* — 51; *P. sp.* — 54. Of these chromosomes 18, 27 and about 22, respectively, appear to be either acrocentric or telocentric. Herbert's (1821) original conception of *Pyrolirion* as a generic entity distinct from *Zephyranthes* is strongly supported by radically different numbers and types of chromosomes encountered in the two groups. Bentham and Hooker's (1883) inclusion of *Pyrolirion* with *Zephyranthes* (followed by Baker, Pax, and Hoffman, Hutchinson and Traub—but not by Strapf or Sealy) seems definitely erroneous.

6. SHOWALTER, A. M., Madison College. *Hybridization of native American lilies.* Five species of the genus *Lilium* occurring east of the

Rocky Mountains have been intercrossed by previous breeders. About 20 species and subspecies occur west of the Rockies. These western species and subspecies have been intercrossed and improved varieties have been developed. These do not generally thrive in the West. The present investigator has had some initial success in crossing eastern species and hybrids with western species and hybrids. Some of the new east-west hybrids may be useful in gardens both in the east and in the west.

7. THOMPSON, JESSE C., JR., AND MARGARET VIRGINIA CONE, Hollins College. *The Buccal Infraciliature of Sathrophilus (Saprophilus) muscorum* (Kahl, 1931; Corliss, 1960). A shallow buccal cavity approximately 10.7×6.1 microns is located near the anterior end. The infraciliature consists of three membranelles (M_1 , M_2 , M_3) on the floor of the buccal cavity and the undulating membrane (U. M.) on the right hand edge. M_1 is the largest and is found anterior to the U. M. M_2 is located at the anterior edge of the U. M. and is unique in shape. It contains a bar of granules which lies at right angle to the end nearest the U. M. M_3 is the smallest and is located posterior to M_2 . The U. M. consists of a row of closely set granules along the right hand edge of the buccal cavity. A break occurs in this row of granules at the posterior end of the buccal cavity. Three granules are almost always found after this break. The U. M. striations appear posterior to M_3 and converge toward the cytostome.

8. BRUMFIELD, ROBERT T., AND MARVIN W. SCOTT; Longwood College. *Nucleic Acids and Root Geotropism*. Ribonuclease modifies the pattern of geotropism in timothy roots and digests a proteinaceous, jelly-like material which covers the root cap and meristem. The digestion of the material is hastened by 2, 4, 6-trichlorophenoxyacetic acid, a compound which alone completely inhibits geotropism without markedly affecting growth. These results indicate that RNA is involved in the control of root growth and therefore the effects of nucleic acid components on growth and geotropism are being tested. In general, purines, pyrimidines, and their nucleosides are stimulatory while the nucleotides are inhibitory.

9. WORONECKI, PAUL P., Virginia Polytechnic Institute. *Rabbit Pellet Durability*. Since Pellet counts are used to evaluate wildlife management practices, a study was made regarding the durability of rabbit pellets. Fresh pellets, obtained from trapped animals, were placed under various environmental conditions to determine what natural phenomena effect the persistence of pellets. During the summer and fall, the primary cause of pellet loss was due to ants and earthworms and decomposition was secondary. Detrioration of pellets slackened during cold weather and loss of pellets to natural causes became negligible. Only freezing and thawing of the soil contributed to any substantial loss of pellets during the winter months.

10. WASS, MARVIN L., Virginia Fisheries Laboratory. *Preliminary Studies on York River Infauna.* Bottom sampling during the fall and winter of 1960-1961 indicates a marked diversity of fauna in the York River. Several animal communities, based on the numerically dominant species, have been tentatively determined. Populations of some species evidently undergo considerable seasonal fluctuation. The number of species present in an area is generally proportional to the diversity of substrate.
11. MENGBIER, WILLIAM L., Madison College. *The Use of a Glass Differential Microrespirometer In Measuring Oxygen Uptake of Planarian Fragments Treated with Na-L-Thyroxine.* A glass microrespirometer, as designed by Grumbaum, et. al., was utilized to measure the oxygen uptake of anterior and posterior segments of *Dugesia tigrina* after treatment with Na-L-Thyroxine. Tail fragments placed in 3.13×10^{-5} M N-L-Thyroxine for 48 hours exhibited a significantly higher $Q O_2$ than did controls; head segments also showed an increased uptake but with a large deviation from the mean.
12. PUCKETT, D. HUGH, AND JEAN E. PUGH, Norfolk, College of William and Mary. *Preliminary Observations on Neurosecretion in the supraesophageal ganglion of the crayfish.* The neurosecretory regions of the supraesophageal ganglion of the crayfish will be discussed with emphasis on cell types, histology and relationships of the neurosecretory cells to other parts of the ganglion.
13. OLIVER, JANE L., Randolph-Macon Woman's College....*A Study of the Effects of Thiourea on the Thyroid, Liver and Kidney of Chick Embryos.* Chick embryos at 10 days of incubation were injected with 0.25 ml. of a sterile 0.2M thiourea in 0.9% saline solution. The controls were injected with 0.25 ml. of a sterile 0.9% saline solution. The eggs were returned to incubation and a number of experimentals and controls were sacrificed at 14, 17, 19, and 21 days. The thyroids, kidneys, and livers were removed and examined microscopically for changes brought about by the above treatment.
14. HARDY, JOE W., Virginia Polytechnic Institute. *Location and Examination of the Blackbird Roost in Dismal Swamp.* The largest blackbird roost in the eastern United States was located and studied in detail during the winter of 1960 and 1961. The roost, containing 15-20 million birds, was found in a large broadleaf evergreen thicket in the heart of the Great Dismal Swamp. In an attempt to identify this roost with summer crop damage areas, birds were banded. With the assistance of Fish and Wildlife Service personnel, a large floodlight trap was operated in the roost.
15. POWELL, JAMES R., University of Richmond. *Blood oxygen capacity of *Columbia livia*.* The blood oxygen capacity of *Columbia livia*

was measured according to the Roughton-Scholander syringe technique. On a unit weight basis, the parameter investigated was found to decrease logarithmically with increase in body weight.

SECTION OF CHEMISTRY

Minutes of the 1961 Business Meeting. The business meeting of the Chemistry Section was held at 12:00 P.M., May 12, 1961. A motion to dispense with the reading of the minutes of the previous meeting was carried. The report of the Nominating Committee was presented by Mary E. Kapp. The committee offered the following slate of officers for the 1961-1962 year: Chairman, Everett C. Cogbill; Secretary, Ralph G. Steinhardt, Jr.; member of the Council (two-year term), G. Tyler Miller, Jr. These officers were elected by unanimous vote. No further business was brought before the Section.

1. JOHN H. WISE and EDWARD B. EADIE, JR., (Robert E. Lee Research Scholar); Washington and Lee University; *Atomic and Molecular Models; Styrofoam models of atomic orbitals* (similar to those described by Lambert¹) and of molecular structure (the set prescribed by Sanderson² except for color scheme) were exhibited. The atomic orbital models were grouped into three categories to indicate (1) normal *s* and *p* orbitals, (2) hybridized orbitals and (3) normal *d* orbitals. The various models were used to demonstrate charge-size relationships, bond formation and simple crystal field ideas. (1) F. L. Lambert, *J. Chem. Educa.*, 34, 217, (1957). (2) R. T. Sanderson, *ibid*, 36, 507, (1959). (3) R. G. Pearson, *Chem. and Eng. News*, 37, 72, June 29 (1959).

2. HERMAN H. FORSTEN and NELSON F. MURPHY; Virginia Polytechnic Institute; *Corrosion of Aluminum by Acid Vapors*; The rate of weight gain of aluminium in nitric acid vapors and in hydrochloric acid vapors of various compositions and at various temperature levels has been studied. A relatively simple and inexpensive system developed by W. H. Jago was used for the continuous measurement of the weight change of the corroding specimens. The essential features were a modified analytical balance, the left side of which acted as a second-class lever, a three-necked flask submerged in a constant temperature bath and a glass thread from which the sample was suspended. The rate of weight gain was found to be a linear function with respect to time and exponential with respect to temperature and acid concentration. A maximum rate occurred at a nitric acid concentration of 40 wt. % and at a hydrogen chloride partial pressure of 1.77 mm Hg. The decrease in rate is attributed to protective amorphous

oxide and chloride films, respectively. The activation energies were approximately constant indicating that the same mechanism is limiting the rate both above and below the maximum.

3. W. A. JESSER and K. R. LAWLESS; University of Virginia; *Twin Growth Structures on Single Crystal Catalyst Surfaces*; Electron diffraction and microscopy have been used to study the surfaces of single crystal catalysts of copper after the hydrogen-oxygen reaction. Interesting sheet like growths were observed about 500-1000 \AA thick and diffraction showed that these have a twin relationship to the copper substrate. Diffraction studies indicated that most of these growths were copper, but that some were cuprous oxide.

5. THOMAS I. CROWELL, CHARLES E. BELL, JR., and DANIEL H. O'BRIEN; University of Virginia; *The Mechanism of Schiff Base Formation*; The kinetics of the reaction of n-butylamine with a series of substituted benzaldehydes were determined in methanol and in dioxane at several temperatures. The more highly hindered *t*-butylamine was also studied. The rates, which did not follow a linear Hammett equation, were interpreted in terms of the consecutive steps of the mechanism.

5. RICHARD K. McLEOD and THOMAS I. CROWELL; University of Virginia; *Reaction of Ammonia with an Aromatic Aldehyde in Dilute Solution*; The reaction of p-dimethylaminobenzaldehyde, at very low concentrations, with ammonia in methanol, is very similar to its reaction with primary amines to form Schiff bases. The reaction rate was measured spectrophotometrically at 0° and 25°, the energy and entropy of activation calculated and the equilibrium constant determined for the reaction $\text{ArCHO} + \text{NH}_3 \rightleftharpoons \text{ArCH}=\text{NH} + \text{H}_2\text{O}$. The formation of the imine was indicated by the close correspondence between this reaction and Schiff base formation with respect to reaction order, the values of the energy and entropy of activation and the ultraviolet spectra of the products.

6. RALPH G. STEINHARDT, JR., and LESLEY L. WILLIAMS; Hollins College; *Surface Tension and Intermolecular Energy of Pure Non-Polar Organic Liquids*; Previous work showing a constant ration between the inter-molecular association energy and the square root of the surface tension of liquids composed of quasi-spherical molecules has been generalized to include all non-polar organic liquids. It is assumed that a molecule of such a liquid may be represented by a prolate spheroid. The effective volume occupied by the molecule in the liquid may then be represented by an oblate spheroid. It was shown that a constant relationship exists between the ratio of the major and minor axes of the effective molecular volume and the ration of the length and diameter of the actual molecule. This relation-

ship is virtually temperature-invariant. It was also shown that the value of $E_a/\gamma^{1/2}$ (E_a = intermolecular association energy; γ = surface tension) is unaffected by molecular size in the case of quasi-spherical molecules. It was shown finally that an approximate relationship exists between the heat of vaporization, the surface tension and the dimensions of the molecules of which a liquid is composed.

7. D. BETTERIDGE and JOHN H. YOE; Pratt Trace Analysis Laboratory, University of Virginia; *A New Spectrophotometric Reagent for the Determination of Traces of Magnesium*; 5-(*p*-Nitrophenylazo)salicylic acid (sodium salt) was examined as a colorimetric reagent for the determination of magnesium at concentrations of 0.1 - 5 p.p.m. The reaction is sensitive, the value for the sensitivity varying with conditions. The optimum conditions and the unexpected effects of varying alkaline earth interference were discussed.

8. VIRGINIA C. CHAMBLIN and JOHN H. YOE; Pratt Trace Analysis Laboratory, University of Virginia; *A Study of Some Hydroxamic Acids as Spectrophotometric Reagents in Trace Metal Analysis*; The reactivity of the hydroxamic acid group with iron has long been known. The study is being extended to other cations, such as vanadium, manganese and uranium. Many hydroxamic acids give color reactions. These and other cations offer promise as useful spectrophotometric reagents. A variety of hydroxamic acids was synthesized. An effort was made to correlate their sensitivity with certain substituents and reactive groups.

9. H. H. GARRETSON, JAMES CHARLES and CLARENCE McCANNA; Lynchburg College; *The First and Second Ionization Constants of Phenolphthalein*; The ionization equilibrium species of phenolphthalein have been studied by making partitions between chloroform and a range of aqueous buffer solutions. The concentrations of phenolphthalein were determined spectrophotometrically. The results are in good agreement with the well-known behavior of this familiar acid-base indicator.

10. OTEY HELM HAYWARD; Mary Baldwin College; *A Report on the Partial Chemical Analysis of Horse Chestnuts*; The mahogany brilliance of the horse chestnut (*Aesculus Hippocastanum*), as it drops from the tree in the early fall, has fascinated young and old alike. While the population of this species has been reduced by blight and drought, prolific bearers are found in the Shenandoah Valley. It has long been said that the nut is poisonous. Chemical literature gives meager information of attempts to analyze. An endeavor to determine the alkaloids has led to the identification and determination of saponin, nitrogen, fats and other products. It is hoped by a continued study to isolate and identify additional products.

11. FRANCIS GARNER and DONALD F. NIEMAN; Alpha Chi Sigma and the University of Virginia; *Boy Scouting and Chemistry*; The University of Virginia Chapter of ALPHA CHI SIGMA is working on a program to present six hours of instruction and six hours of laboratory work in chemistry to Boy Scout Troop 134 in Charlottesville. This effort is similar to one made by the ALPHA CHI SIGMA Chapter of the University of California (Berkeley) and repeated in the Chemistry and Engineering News. However, the Virginia program represents an extension in that it embraces a wider age group of boys beginning with age eleven. The intent is not only to prepare boys for Scouting's Chemistry Merit Badge, but also to instill an interest in basic science at a relatively early age. Results of the program, which ran from February 27 to May 8, 1961, were presented.

12. J. S. OSBORNE, JR., and A. E. WRIGHT, JR.; The American Tobacco Company; *The Temperature Distribution in a Free Burning Cigarette*; Thermocouple measurements were employed to map the distribution of temperatures in a blended cigarette. The temperature distribution was described in terms of "isothermal surfaces" through the adoption of suitable conventions. The presumptive maximum temperatures, which have previously been reported in the literature, were shown to represent true axial maxima and the reported values corroborated. The measurements extended over the entire cigarette space and afforded an experimental basis for delimiting the primary smoke formation system of the cigarette.

13. W. STEPKA and L. J. DEWEY; The American Tobacco Company and the Medical College of Virginia; *Conversion of Nicotine to Nornicotine in Harvested Tobaccos Fate of the Methyl Group*; the metabolic conversion of nicotine to nornicotine by a converter strain of cigar tobacco was investigated with the aid of randomly and specifically C^{14} -labeled nicotines. The experiments represented an attempt to trace the fate of the methyl group during the demethylation of nicotine in detached leaves of tobacco. Such studies could provide a more adequate basis for a choice between suggested schemes based either on transmethylative or on oxidative reactions. It was found that the conversion occurs only under aerobic conditions and that the N-methyl carbon of nicotine is oxidized to CO_2 . The data did not permit a choice of the mechanism for the initial steps of the reaction but did show that the over-all course follows an oxidative pathway. An additional experiment with $C^{14}O_2$, testing the reversibility of the over-all reaction, showed that the reaction is irreversible.

14. JOHN I. DALE, ROBERT E. LUTZ and C. L. DICKERSON; University of Virginia; *Phenyl Group Migrations in Highly Phenylated Systems*; Pyrolysis of cis-dibenzoylstilbene gives 3,3,4,5-tetraphenyl-dihydrofuranone-2, and heating with methylamine gives 1-methyl-3, 3,4,5-

tetraphenylidihydropyrrolone-2 (known reactions). Addition of phenyllithium to these compounds produces 1,2,2,3,4-pentaphenylbutan-1,4-dione (I) and 1-methyl-2,3,4,5-pentaphenyl-2-hydroxydihydropyrrole (II), respectively. Treatment with acid causes rearrangement of I and II to 2,3,4,5,5-pentaphenylidihydrofuranol-2 (III) and the corresponding 1-methyl-2,3,4,5,5-pentaphenyl-2-hydroxydihydropyrrole (IV). Hydroxide ion attacks the 1-carbonyl group in I causing fission and induces an analogous reaction at the 2-position in II. Zinc-acetic acid reduces III 1,6 to 1,1,2,3,4-pentaphenyl-1-buten-4-one, but apparently reduces II and IV to pentaphenyl-N-methyldihydropyrroles. Acides dehydrate II and IV to pyrrolenine salts, the first rearraging readily to the second. Spectral studies, structural relationships and mechanisms were discussed.

15. JOSEPH W. FEIFER and ROBERT E. LUTZ; University of Virginia; *Conjugate Reactions of Phenoxides With β -Bromo- β -Aroylacrylic Acids*; Sodium phenoxide reacts with cis and trans- β -bromo- β -aroylacrylic acid and the diastereoisomeric α , β -dibromopropionic acids yielding the same two compounds, α -phenoxy- β -aroylacrylic acid, and its hydrolysis product, α -hydroxy- β -aroylacrylic acid, which were not isomerizable by sunlight irradiation. The position of the phenoxy group was proven by ozonization in a polar solvent to α -hydroperoxy- α -methoxyacetophenone. In contrast, in a specific case, p-cresoxide reacts with the above starting acids yielding α -hydroxy- β -aroylacrylate-p-cresoxy ester and its acid (contrary to literature). For this anomalous formation of an ester under alkaline conditions, a possible explanation was discussed in terms of ring-chain tautomerism and a cyclic intermediate state.

16. ROBERT E. LUTZ, HENRY MONCURE, JR., and JOSEPH P. FEIFER; University of Virginia; *Ring Chain Tautomerism in the Cis β -Bromo and β -Methyl β -Aroylacrylic Series*. Synthesis, structures, ring-chain relationships and effect of para-substituents in the β -bromo series were described in detail; also trans-eliminations of hydrogen bromide from arylacrylic dibromides. 1,4-Methanolysis of the cyclic acid chloride was demonstrated. Conditions affect ratios of 1,2-solvolytic vs. 1,4- SN_2 -attack on cis(cyclic)- β -methyl- β -bromobenzoylacrylic acid chloride, by methanol and methoxide ion, to cyclic and acyclic esters, respectively (followed spectrophotometrically). 1,2 vs. 1,4 rate ratios were: by methanol, 87:13 at 0°; 75:25 at 25°; by methoxide ion, predominantly 1,4, increased sharply by temperature and concentration rise. Ester equilibrium is shifted from predominantly cyclic in methanol to ca. 80% by methoxide ion, presumably by anion addition.

17. WILLIAM R. SMITHEY, JR.; Virginia-Carolina Chemical Corporation; *Some Uses and Abuses of Phosphorus Compounds in Organic Chemistry*. The usual applications of phosphorus chlorides, oxychlorides and

oxides in elementary organic chemistry were reviewed and some misconceptions noted. A short introduction to organic phosphorus chemistry to include fundamental reactions and nomenclature was suggested for possible inclusion in elementary organic chemistry courses. The major uses of inorganic and of organic phosphorus compounds were discussed. Advantages and limitations of various reactions were considered.

18. WENDELL M. BYRD, JR., and VASCO G. CAMACHO; Virginia-Carolina Chemical Corporation; *Some Aspects of the Chemistry of the Trialkyl Phosphites*. Trialkyl phosphites are prepared by the reaction of an alcohol with a phosphorus trihalide. Another synthetic method is transesterification. This is useful for preparing higher molecular weight and mixed phosphites in excellent yields. These reactions were discussed in relation to catalysts, reaction conditions and general applicability. Potential use of phosphites as esterification agents was considered.

19. JAMES K. SHILLINGTON, RARDON D. BEVILL III, and HENRY C. HAWTHORNE, JR.; Washington and Lee University; *The Synthesis of Hydrazidomalonic Acid and Its Use as a Carbonyl Reagent*. The common derivatives of aldehydes and ketones such as phenylhydrazone, substituted phenylhydrazone, oximes and semicarbazones and many lesser known condensation products are described extensively in the literature of qualitative organic analysis. However, it appears that little use has been made of the monohydrazido derivatives of the diacids. Hydrazidomalonic acid was synthesized by hydrazination of potassium ethyl malonate. The acid, usually not isolated, was condensed as its potassium salt with the carbonyl compound. Ready condensation with a number of carbonyl compounds showed the reagent to be versatile and the derivatives to be stable crystalline solids with suitable melting ranges.

20. FRANK A. VINGIELLO and EDWARD J. GREENWOOD; Virginia Polytechnic Institute; *The Synthesis and Reactions of 7-(2-Carboxyphenyl)-Benz [a] anthracene*. The Grignard reagent from 1-(1-naphthylmethyl) 2-bromobenzene was allowed to react with phthalic anhydride. After appropriate 'work up' this gave 2-(1-naphthylmethyl) 2'-carboxy benzophenone. This ketone was subjected to an aromatic cyclo-dehydration reaction to give 7-(2-carboxyphenyl)-benz [a] anthracene. The proof of structure of this compound as well as several of its interesting reactions were discussed.

21. THURMAN T. GROSSNICKLE, HORST JENSSSEN and CLIFTON H. WILSON; Bridgewater College; *Syntheses From 15-Oxygenated Steroidal Sapogenins*. A new steroidal sapogenin has been isolated from commercial digitatonin and its structure established as 5α , 25α -spirostanane- β , 15β -diol. The 15-hydroxyl group of this new sapogenin and of

digitogenin and neodigitogenin has provided a means of synthesizing a number of new steroidal compounds substituted at C₁₅ or with ring D enlarged. Those derivatives related to steroidal hormones are of special interest because of their potential therapeutic use.

22. ALLEN K. CLARK, W. F. LITTLE, C. NOE, and J. BENNER; Norfolk College of William and Mary, and University of North Carolina. *Some Reactions of p-Bromophenylferrocene and m-Bromophenylferrocene.* p-Bromophenylferrocene and m-bromophenylferrocene have been prepared for the purpose of investigating the Grignard reaction of these compounds. The Grignard reagent of p-bromophenylferrocene was prepared and reacted individually with water, CO₂ and benzophenone to yield phenylferrocene, p-ferrocenylbenzoic acid and p-ferrocenylphenylidiphenylcarbinol, respectively. The first two products were also synthesized by alternate methods. The Grignard reagent of m-bromophenylferrocene was also prepared and reacted both with water and CO₂ to yield phenylferrocene and m-ferrocenylbenzoic acid, respectively.

23. ALEXEJ BORKOVEC, JUDITH B. CHAPMAN and ELIZABETH ANNE GREENE; Hollins College. *Aromatic Ketals.* Recently, Lorette and Howard developed a new and convenient way for the preparation of acetals of ketones. With the use of this method, it was possible to prepare ketals of aromatic ketones which had quite different properties from the aliphatic homologs. The interaction of Lewis acids with aromatic ketals was studied and the theory that the stability of a ketal depends on the presence of a hydrogen in Alpha-position to the acetal carbon was substantiated.

SECTION OF ENGINEERING

BUSINESS MEETING

Peter Henry was the winner of the 1961 George Washington Engineering Award. He is a student of Warwick High School, Newport News, and was sponsored by Colonel Snead. At the next meeting two current sessions are planned, with no limit on the number of papers to be presented. Officers elected to serve for the next year are: *Chairman* James B. Eades, Jr.; *Vice Chairman* John F. Eckel; *Secretary* John A. Friedericy; *Editor* Nelson F. Murphy; *Member on Council* Stuart B. Row; *Member on History of Science Committee* Robert M. Hubbard. Chairman Stuart B. Row presided over the meeting.

PROCEEDINGS

1. BOOTH, J. R. and MURPHY, NELSON F. Virginia Polytechnic Institute. *The condensation of water vapor near its triple point.* The condensation of water vapor, as a solid, from humid air has been studied, and the rate equation describing this condensation proposed. Experimental work was performed to determine time variable coefficients in the rate equation. Using the coefficients evaluated, it was possible to predict the weight of vapor condensed as a function of time, when the vapor condensed as a solid. When the condensation changed from solid to liquid, the rate became constant and was given in the literature.
2. SPARKS, CAPT. N. W. University of Virginia. *Examination of the effective multiplication factor of University of Virginia subcritical assembly.* The University of Virginia Subcritical Assembly is a natural uranium, light water heterogeneous reactor similar in construction to those commercially available. The fuel is in the form of hollow cylindrical slugs, $8\frac{1}{2}$ inches long. Three values of k_{eff} are presented and compared. Two values are calculated by applying one-group, Fermi-modified, diffusion theory to a three-region equivalent unit cell. One value is computed using only first order considerations. The second value contains many higher order corrections. A third value is determined experimentally and compared to the two calculated values. Future work will extend the comparison by applying two group theory.
3. STUART, MAJ. J. A. Virginia Polytechnic Institute. *Parametric study of the effects of non-equilibrium flow in nuclear rocket propulsion.* This paper presented an evaluation of certain performance parameters for frozen, equilibrium, and non-equilibrium flow conditions using hydrogen gas as a working substance in a nuclear, thermal nozzle, rocket propulsion system. This evaluation was accomplished by utilizing the dissociating gas concept of Lighthill, and the hypersonic nozzle analysis of Bray. Results of the evaluation show the effect of variation of stagnation temperature and pressure on the specific impulse.
4. WEST, CAPT. T. C. Virginia Polytechnic Institute. *The solar sail as a means of interplanetary travel.* Solar radiation is known to exert pressure on an intercepting surface. The pressure is small but if applied for long periods of time in space, the resulting velocities are appreciable. The inexhaustible power source is an obvious advantage. The dynamics of vehicles so powered do not admit to a closed form solution in the general case. Certain particular solutions are available in closed form, one of which is the logarithmic spiral. Since this solution is limited in applicability and is not optimum, this paper presents a more optimum solution using the spiral for comparison.

5. JACKSON, AUZVILLE, JR. Robertshaw-Fulton Controls Company. *The innovator-engineer should have a current working knowledge of patents.* The innovator-engineer should have an up-to-date working knowledge of the obtaining and use of patents because of such factors as the shrinkage of the time between conception and introduction of innovations, the shrinking world, the shrinkage of the time between introduction and plagiarism by others, the shrinkage of profits used for research and development, and the accelerating importance of innovation.

6. DAVIS, H. J., PR. University of Virginia. *Analysis of velocity selectors for molecular beams.* A design of a multi-disc velocity selector is presented and discussed. The selector eliminates all molecules which do not have a prescribed velocity by suitably locating the selector discs. The selected molecular velocity is determined by the angular speed of the selector. Methods for determining the relative placement of selector discs are given for a selector with either straight or helical slots. The helical slot selector is shown to have higher transmission. The final selector has a molecular velocity range from 7.68×10^3 to 4.5×10^6 cm/sec, a maximum angular speed of 400 rps, and a resolution of 10%.

7. FOSTER, GEORGE N. and ROW, STUART B. Virginia Polytechnic Institute. *A study of the bonding mechanism between thermoplastic materials.* This paper concerns the development of an infrared spectrometrical method for studying the bonding mechanism between thermoplastic materials. Beer's Law for light absorption by liquid solutions has been modified and applied to solid plastic solutions and heterogeneous plastic mixtures. The modified form of Beer's Law provides a means for investigating the changes taking place at the interface of two dissimilar plastics during lamination. The results indicate that Beer's Law can be applied to solid solutions and heterogeneous mixtures of thermoplastic materials.

8. CROSBIE, K. L. University of Virginia. *Laboratory demonstration model of a plasma thermocouple.* The plasma thermocouple has a nuclear heat source cathode of graphite containing 0.4 g of uranium-235 suspended from the center electrode of a spark plug, and a stainless steel anode which contains a pool of liquid cesium. The cesium vapor supplies the plasma which serves as a space charge eliminator. The unit, insulated with asbestos and housed in an aluminum can, will be placed next to the core of the University of Virginia reactor to determine the lifetime and power output. The open circuit voltage and short circuit current method will be used to determine the power output, and the lifetime will be determined by operating until failure.

9. HASSAN, H. A. Virginia Polytechnic Institute. *Skin friction in unsteady slip flow.* The effects of acceleration on skin friction in the slip flow regime are discussed. It is shown that, for the class of pressure distribution considered, the slip flow equations have a series solution whose coefficients are governed by second-order linear differential equations which have known solutions. The results indicate that the acceleration has a second-order effect on skin friction.

10. SCOTT, JOHN E., JR. and BUNTING, JACKIE O. University of Virginia. *Molecular beam scattering from a rapidly moving target.* The physical reasoning and analysis of the scattering of neutral beam molecules from a surface moving at high speed has been described by Bodine and Davis. This type of experiment is intended to shed some light on the nature of the energy and momentum exchange accompanying the scattering of a neutral molecular beam from a solid surface. An electromagnetically supported rotor is described which is driven from outside the vacuum chamber by an alternating magnetic field such that surface speeds of the order of 6×10^4 cm/sec can be obtained. The detector and traversing system for the scattered beam is discussed.

11. BARTON, E. E., VAN REUTH, E. C. and ECKEL, JOHN F. Virginia Polytechnic Institute. (Supported by U. S. Atomic Energy Commission). *A study of the Cr_3O type structure in two ternary systems.* In approximately thirty-seven binary alloy systems the Beta-Tungsten (Cr_3O) intermetallic phase is known to exist. The governing factors regarding the formation of the phase are not known although empirical limits have been reported. An investigation of the V-Si-Sn system, in which V_3Si and V_3Sn exist, established that Sn atoms substituting for Si atoms in this structure. Lattice parameter measurements indicate a positive deviation from Vegards Law. In the Cr-Si-Sn system, which contains Cr_3Si , Sn atoms could not be made to substitute for Si atoms. Studies are continuing to determine the relationship between atomic size factor and electron configuration in these Cr_3O type structures.

12. BRUNOT, ILLIAM K. University of Virginia. *Fuel element surface temperature in the University of Virginia reactor.* Surface temperatures will be measured at five points along the axial length of a fuel plate, using .040 inch diameter mineral-insulated sheath-type thermocouples. The copper-constantan thermocouple wires will be soldered to the surface of a removable plate in a special fuel element assembly, and the plate will be replaced in the assembly. Coolant flow will be measured in several channels of the fuel element and correlated to the gross flow in the element in an out-of-pile flow rig, using .062 inch diameter pitot-static tubes and slant leg water manometers. The heat generation per

unit volume of fuel will be determined by low power flux measurements using foils.

13. KINNLER, H. L. and SLEPETZ, J. M. University of Virginia. *Vibration studies of highway bridges.* Interest in the phenomena of bridge vibrations has been precipitated by recent design trends. Consequently, the writers have undertaken studies of vibration in highway bridges and various design parameters affecting vibration. Preliminary tests were performed on simple span bridges using a loaded vehicle to excite vibrations and a piezoelectric crystal to measure response. The results were complicated by uncertainties regarding vehicle behavior; however, useful information concerning existing theory and the influence of design features was obtained. In current studies a mechanical oscillator is used to excite vibrations. Control of the exciting force has resulted in useful data for reevaluating bridge performance.

14. TRUITT, ROBERT W. and PERKINS, JOHN N. Virginia Polytechnic Institute. *Thermodynamics of the ideal r-times ionized monatomic gas.* The governing thermodynamic equations of an ideal r-times ionized gas are derived for the equilibrium case. These equations are non-dimensionalized by introducing characteristic quantities (temperature, pressure and energy) which are constant for a given r-times ionizing ideal gas. It is shown that completely analytical forms may be given for the characteristic quantities for the special class of hydrogen-like gases. An approximate formula is derived whereby one may determine the temperature range for any gas for the ionizing process A_r to A_{r+1} . Corrections for Coulombic interactions are discussed briefly.

15. SHAFIQUE, M. University of Virginia. *Power calibration and flux measurement of the University of Virginia nuclear reactor.* Neutron flux was mapped along the vertical axis of fuel elements using pure aluminum slugs, a hydraulic rabbit, and a scintillation counter. The reactor was maintained at nominal zero power. The counter was standardized against a known flux from a graphite pile. Flux in control rod fuel elements was estimated by horizontal extrapolation. Average neutron flux (9×10^6 neutrons/cm²-sec) in the reactor core was found by graphical integration, and the average neutron flux was normalized at one watt of power. The reactor was taken to power using an independent fission chamber. Finally reactor power was correlated against the mass flow of cooling water and its temperature rise.

16. DOERFLINGER, CAPT. OTTO C. University of Virginia. *Measurement of the Fermi age of 14 Mev neutrons in paraffin and water.* A Kaman pulsed neutron generator Model NT-60-8A, which utilizes a $H^3(d,n)He^4$ reaction and which emits 14.3 Mev neutrons, was assembled

and checked out. Neutron age to indium resonance was measured for the pulsed neutron source and for a plutonium-beryllium source in a block of paraffin that is used as a calibration standard. To verify the validity of the procedure used in measuring the age, measurements were also made in light water and these results compared with those previously reported by other agencies.

17. RICH, J. W. University of Virginia. *An orifice probe investigation of free molecule cylindrical Couette flow.* The analysis and design of a probe detecting molecular flux in free molecule cylindrical Couette flow is presented. An experimental model, using a rotating aluminum cylinder, has been utilized. A fixed outer cylinder placed concentrically about the rotor forms the outer flow boundary. Surface speeds exceeding 1500 fps are achieved. A hyperdermic needle probe, with orifice width smaller than the local mean free path, is inserted into the flow thus generated. Orientation of the orifice may be varied. A standard ionization gauge is used as a detector. Theoretically computed values of molecular flux into the probe are presented and discussed.

18. LOUTHAN, M. R. and ECKEL, JOHN F. Virginia Polytechnic Institute. *Diffusion of carbon in dissimilar metal welds.* (Study sponsored by Oak Ridge National Laboratory). Engineering applications frequently require dissimilar metal welds to be exposed for long periods of time at elevated temperatures. Such exposures cause diffusion and property changes in the weld. The extent of carbon diffusion from carbon steels to AISI 304 was determined by emasuring the width of the decarburized band in the carbon steels using metallographic techniques. Diffusion coefficients which were calculated from these measurements showed reasonable comparison to previously determined diffusion coefficients for carbon in alpha iron. These calculations indicate that the major part of carbon diffusion occurs during the early stages of exposure.

19. CHITNIS, V. D. University of Virginia. *Two group flux distributions for the University of Virginia nuclear reactor using a Burroughs 205 digital computer.* A two-group multi-region one-dimensional reactor code is used to determine the flux distributions in the University of Virginia nuclear reactor. The fast and thermal flux distributions can be obtained for any one of the following three geometries; (1) slab, (2) cylinder, and (3) sphere. In the present work only cylindrical geometry is chosen for most of the work. The radial and vertical flux distributions are computed for the reactor, treating it as a right circular cylinder. These results were compared with those obtained experimentally. Water-gap peaking of the thermal flux when the control rod is withdrawn completely is studied and compared with the predictions of the theory.

20. HARRISON, WILLIAM P., JR. Virginia Polytechnic Institute.

Temperature boundaries for ideal dissociating and ionizing gases. With the assumption of independent gas processes the ideal dissociating gas theory of Lighthill and the ideal ionizing gas theory can be used to analyze real-gas systems in equilibrium experiencing the effects of dissociation and single ionization, provided the range of application of each of the two theories is known. In this paper an analytical expression is developed which gives the limiting temperature as a function of pressure for the ideal dissociating gas theory, the resulting values constituting a pressure-temperature division boundary separating the range of application of the ideal dissociating gas theory from that of the first-level ideal ionizing gas theory.

21. SCOTT, JOHN E., JR., ZAPATA, RICHARDO N. and DREWRY, JAMES E. University of Virginia. *Elastic scattering in molecular beam formation.* Phenomena causing attenuation and broadening of molecular beams of nitrogen are investigated using a conventional molecular beam system. Variation of the source pressure is employed to study the entire flow range from free molecular to continuum. Angular distributions of intensity of molecular beams are reported as a function of source and collimator chamber pressures. Emphasis is placed on the effects of self scattering of the beam and beam scattering caused by collisions of beam molecules with background molecules in the collimator chamber. A simple theory is presented to aid in the interpretation of the experimental data.

22. DURFEE, ROBERT S. Atlantic Research Corp., A. R. JONES and C. J. HOCHONADEL, Oak Ridge National Laboratory, and STUART B. ROW, Virginia Polytechnic Institute. *A stable dosimeter for the measurement of ionizing radiation.* The need of a small, stable dosimeter for a Van de Graff generator led to the investigation of pressed pellets of potassium bromide containing trace amounts of nitrate ion. The decomposition of nitrate ions during gamma radiation was reproducible to within two percent. By cooling, this dosimeter can be used with dose rates from 10^4 to 10^7 roentgens per hour.

23. ZUK, WILLIAM. University of Virginia. *The role of intuitive methods in engineering.* With science and engineering given every encouragement in this age to develop new frontiers, every intellectual resource should be utilized for this achievement. Although used clandestinely, intuitive intellectual methods are rarely openly encouraged in engineering. It is thus the object of this paper to show a valid basis for use of intuitive methods, to demonstrate its proper use and misuse, and to suggest various practical ways of utilizing this precocious activity.

24. ZAPATA, RICHARD N., JOHN E. SCOTT, JR., and JAMES E. DREWRY. University of Virginia. *An experimental aspect of the pro-*

duction of molecular beams with a hypersonic nozzle. The theoretical and experimental aspects of the production of aerodynamic molecular beams of atmospheric gases have been presented by Zapata and Parker. The experimental analysis revealed the presence of deleterious effects both upstream and downstream of the skimmer, or first orifice. The upstream effects were attributed primarily to the lack of sufficient sharpness of the skimmer lip, which favored the formation of normal shocks. New experiments tend to show that the dissipation of the supersonic flow in front of the skimmer may be partially due to the interaction between background molecules and beam molecules in the nozzle discharge chamber.

25. MOSS, F. E. University of Virginia. *Design of an in-pile loop experiment.* The high temperature and economic advantages of the gas-cooled nuclear reactor with nuclad fuel elements, as a heat source for steam power plants, are offset by the problem of fission product diffusion from the fuel into the primary coolant loop. Removal of the fission products on the surface of a dust suspension in the coolant gas has been proposed. Evaluation of this scheme with an in-pile loop experiment is the subject of this paper. The neutron flux and temperature within a test fuel element placed near the University of Virginia nuclear reactor are computed, and estimates of the total diffusion of Xe-138 and Cs-138 into a gas coolant loop are made.

26. HARRIS, JULIUS E. and ROBERT W. TRUITT. Virginia Polytechnic Institute. *Real gas effects in propulsion performance.* The Lighthill, Freeman, Bray approach is developed, and a procedure outlined for the solution of the resulting equations. The theory is then applied to the flow of dissociating hydrogen gas through a nuclear, thermal-nozzle system under the conditions of frozen, equilibrium, and non-equilibrium flow. The analysis clearly points out, for the case considered, that the assumption of equilibrium flow would result in an overestimation of thermal-nozzle performance for area ratios above 4.

27. SIEGEL, CLIFFORD M. University of Virginia. *Demonstration instruments for teaching electrical engineering.* The writer is developing instruments of which each demonstrates an array of electrical phenomena and principles (in action, not simulated) and is available throughout each day for student operation without supervision. One instrument, occupying 14" x 19" x 13" space, displays thirty electronic components and oscilloscopically presents their current-voltage characteristics. Another demonstrates a variety of meters responding to various different properties of voltages having a variety of different periodic waveforms. A third instrument displays polyphase and single-phase transformer connections, rectifier circuits and associated filter and load circuits. Students participate by observation, turning knobs and operating switches.

28. BELL, ROLAND N. Virginia Polytechnic Institute. *An approximate solution to the properties of the flow about a blunt body in a hypersonic stream.* An approximate solution to the flow around a blunt body in a hypersonic stream is developed based on body shape and taking into account the effects of departure from equilibrium. The method employed was to assume that the flow around the body corresponds to the flow in a suitable hypersonic nozzle. To determine the accuracy of this approximate solution, an example problem was solved and the results compared with those obtained from an exact solution. Results of the approximate solution were found to closely parallel those of the exact solution with a maximum error of less than 20 percent for most of the parameters considered.

29. FRIEDERICY, JOHN A. University of Virginia. *On the use of a physical model in the analysis of shallow spherical shells.* The two non-linear differential equations which govern the elastic behavior of large deflections of shallow spherical shells are extremely complicated. Laborous numerical procedures have been used by others to find approximate solutions for stresses and displacements. The equations are limited to shells subject to symmetrical deformations under uniform external pressures. This study is concerned with analysis of deformation behavior as a function of time of a shallow spherical shell subjected to varying axially symmetrical pressure distributions and to high temperatures which cause creep. An attempt has been made to generalize the differential equations which govern elastic behavior to fit the creep case. This was found to be impossible, and instead a physical model closely simulating shell action has been devised.

30. BARKLEY, WILLIAM A. and STUART B. ROW. Virginia Polytechnic Institute. *The determination of heat transfer characteristics of a moving bed system composed of air and activated carbon.* The purpose of this investigation was to determine the heat transfer characteristics for the design of an improved heat exchanger for a moving bed system composed of air and activated carbon. The desorption of moisture in the activated carbon caused an unexpected break in the thermal conductivity curves between 200 and 220° F, resulting in variable thermal conductivity-specific heat ratios. Rod-like flow was evidenced through a physical test, but poor correlation was observed between the data and the rod-like equation. The over-all heat transfer coefficient varied from one to three Btu/hr-ft²-°F, increasing as the carbon flow rate and the Graetz number, KL/Wc_p , increased.

31. BARRON, CHARLES H., JOHN C. CHATY, RAUL A. GONZALEZ, and JOHN A. ELDRIDGE. University of Virginia. *Thermodynamic properties of isobutylene.* Using the Benedict-Webb-Rubin and the Martin-Hou equations of state, a comparison has been made of the ability

of each equation to fit the experiment PVT data of i-butylene. A complete set of thermodynamic properties: enthalpy, entropy, and volume for i-butylene, has been determined for the saturated vapor and liquid phase and for the superheated vapor. The saturated properties were determined in the region from 0° to 292.5° F. The superheated vapor properties were determined for the region from 70° to 500° F. and from 1 atm to 200 atm.

32. BUCK, CAPT. BRUCE F. University of Virginia. *Neutron, gamma ray, and heat distribution in a neutral thermal column.* The University of Virginia reactor thermal column was designed and fabricated in such a manner as to allow measurements of the temperature distribution, gamma ray flux, and thermal and epi-thermal neutron fluxes throughout the centerline of the assembly. Measurements of these quantities were made and normalized at a power of one megawatt thermal power. An expression for the theoretical temperature distribution as a function of gamma ray heating, neutron absorption heating, and neutron scattering heating was arrived at and compared to the actual measured values to test the validity of these functions for AGOT graphite.

33. FROLICH, J. P. and J. B. EADES, JR. Virginia Polytechnic Institute. *Summary of theoretical and experimental studies of ground effect machines.* The "ground effect machine" is a vehicle operating close to the ground and riding on a cushion of air produced by a jet directed toward the ground. Therefore, the characteristics of the jet have a considerable effect on lifting capability. Assuming an ideal gas, the two-dimensional theoretical augmentation factor (the ratio of lift in ground effect to that out of ground effect) does not agree with experimental data. For three-dimensional machines, however, theoretical and experimental data do agree and, as has been confirmed experimentally, the centerbody has a noticeable effect on the augmentation ratio.

34. HAYNES, K. L., and O. L. UPDIKE. University of Virginia. *Period simulation — a different approach to nuclear reactor kinetics.* Analog simulation of reactor kinetics, though valuable, is complicated by the eight to ten decade power range required between startup and full power. Transformed equations, however, can be simulated to yield reciprocal period, varying over two decades or less and integrable to logarithm of power. The computer program described so simulates a pressurized water reactor from startup to full power, including neutron source, heat transfer system, and one regulating rod servo. Source simulation problems of previous logarithmic simulators are readily avoided. Largest error contribution, fortunately reducible, arises from generation of an antilog by diode-switching methods.

35. MAY, JAMES E. University of Virginia. *Application of electro-*

magnetic suspension techniques to research in rarefied gas dynamics. Aerodynamic force measurements in low density flows are extremely difficult because the forces are very small. This difficulty is enhanced since the finite size of the model support produces a large effect on the model forces. A balance system which will eliminate the latter difficulty will aid greatly in the search for reliable aerodynamic data to check theoretical analyses of momentum exchange at the body surface in the low density regimes. A three-dimensional electromagnetic support system has been developed and will be used as a wind tunnel balance for aerodynamic tests in low density flows.

SECTION OF GEOLOGY

1. COLE, JOHN M. University of Virginia. *Contact Metamorphism in Central Maine.* The metapelites of eastern Penobscot County, Maine, represent a sequence of Ordovician and/or Silurian sediments that was strongly folded, metamorphosed, and intruded by a granite batholith. The strata are dominantly argillaceous, but vary from phyllite, to quartzite, to calcareous quartzite. During regional folding of the Taconian Revolution these sediments were converted to greenschist metamorphic facies rank consisting of quartz, albite, chlorite, and carbonates. The Luceerne batholith, an elongate body of porphyritic granite from 3 to 10 miles wide and 55 miles long, trends northeastward along the regional strike of the rocks of eastern Maine. The coarse-grained, porphyritic granite consists of 60% feldspar, 30% quartz, and 5% biotite. The phenocrysts are twinned and zoned orthoclase with microcline dominating oligoclase in the groundmass. A contact metamorphic aureole, which varies from a few millimeters to about 1 mile in width, was formed in the metapelites by the intrusive granite. Within this contact aureole certain minerals occur in zones which indicate an outward-decreasing thermal gradient. The innermost zone, which is largely coincident with hornfels adjacent to the granite, is characterized by euhedra lalmandine. The garnet composes from 10 to 50% of the rock in a zone having a maximum width of 2,000 ft. Cordierite metablasts, which identify the intermediate zone, are developed in a band 2,000 ft. wide in one area. The outermost zone, which attains a maximum width of 3,500 ft., is defined by metablastic biotite which comprises more than 20% of the rock. The outer extremity of the contact aureole is marked by the dominance of white mica over biotite, and by a change from the schistose nature of the two outer contact zones to the phyllitic texture of the metapelites.

2. CARRINGTON, T. J. Virginia Polytechnic Institute. *Preliminary Study of Some Rhythmically Laminated Tuffaceous Sediments in Southwestern Virginia.* Tuffaceous, rhythmically laminated sediments near Kon-

narock, Virginia, consists of alternate laminae of fine sand sized gray-green, and extremely fine grained red volcanic materials. Each gray-green lamina and overlying red lamina is a *rhythmite*, each ranging from a few mm. to several cm. in thickness with sharp contacts with adjacent rhythmites, and decrease in grain size upwards. Red laminae commonly include multiple, parallel concentrations of material essentially identical to their underlying gray-green laminae. These concentrations are *microrhythmites*, and range from 0.1 to a few mm. in thickness. *Megarhythmites*, similar to rhythmites in color and composition are typically 0.5 to 3.5 m. in thickness. Typical rhythmites are commonly in the gradation zone between the basal gray-green and upper red strata of megarhythmites. Isolated sub- to well rounded granitoid fragments to 1.25 mm. across are sporadically present in the gradation zone, but not in either the basal or upper strata of megarhythmites. Volcanism may have been of the Strombolian or ultra-Strombolian type. Periods of eruptions produced rock fragments, vapors, dust and gases intermittently and were separated by period of relative quiescence. The solid portion of each eruption fell into bodies of water and was size sorted as it settled and formed rhythmites. Intermittent arrival of coarse material from minor eruptions during the settling of the "fines" of previous outbursts resulted in microrhythmite formation. Each megarhythmite appears to represent materials supplied during a major period or cycle.

3. ROBERTS, CLARENCE E. Washington and Lee University. A *Preliminary Study of the Concretions of the Romney Shale, Highland County, Virginia*. Concretions from 4 belts of the Romney shale in Highland Co. are colored more or less as that of the surrounding strata. Common characteristics are: flattening parallel to bedding; bedding planes accentuated by alignment of pyrite; flattened or concave surface on the bottom. Sizes range from 9 ft. in length, 1 ft. in thickness to $\frac{1}{2}$ in. in length and $\frac{1}{4}$ in. in thickness. Shapes are ellipsoidal, oblate-spheroid, triangular-disc or disc, cylindrical, nodular, spherical or irregular. Some seem to be caused by coalescence of several small concretions. No nuclei are found in the concretions, but they do contain may fossil-like structures composed of any one or combinations of the minerals composing the concretions. Gastropods and brachiopods are found in several. Septarian structures are often seen, consisting of one central vein, a network of trellis-like veins, or veins radiating from the center. There are 5 types: (1) phosphorite concretions composed of an apatite mineral, calcite, pyrite, quartz, sphalerite and chloritic clays; (2) carbonate-barite radial concretions composed of calcite, quartz, illite, chloritic clays, barite and pyrite; (3) carbonate-pyrite-quartz concentric concretions composed of calcite, pyrite, quartz, sphalerite and illite; (4) barite concretions composed of barite, pyrite, limonite, quartz and illite; (5) carbonate concretions composed of calcite, pyrite, quartz, ankerite, geothite, illite, chlo-

ritic clays. The relations of concretions to enclosing rocks suggest that the concretions are of syngenetic origin.

4. FITZGERALD, F. B., III, and R. S. MITCHELL. University of Virginia. *X-Ray Diffraction Identification of Selected Heat Treated Metamict Minerals from Virginia.* Heat treatment studies of metamict minerals found in Virginia were undertaken to facilitate identification by x-ray diffraction powder method. Fragments from a specimen of massive allanite found near Peaksville, Bedford, Co., were heated in air for periods ranging from 1/2 to 24 hours. X-ray diffraction showed progressive recrystallization as time and/or temperature increased. A reproducible x-ray pattern ("A" type) was obtained for 1/2 hour at temperatures up to 925°C. Above 925°C another pattern ("C" type) developed at all time intervals. A third pattern ("B" type) resulted for all time intervals above 2 hours at 900°C. "B" was not obtained at 800°C for 24 hours, nor under any other conditions. X-ray data for the "A" pattern matched those known for allanite and are similar to those for epidote. The significance of the "B" and "C" patterns is undetermined. Identification (not detailed study) were made for some other minerals found elsewhere in Virginia. Samarskite and bladed allanite were identified from the Mitchell pegmatite, Bedford Co. The best data for samarskite was obtained after heating the sample at 1050°C for 2 hours. Allanite was verified from Amherst and Roanoke Cos. From the Amelia area fergusonite, microlite (Rutherford Mine) and pyrochlore (Champion Mine) were identified. A specimen from Powhatan Co. gave data suggesting betafite, a mineral previously unreported from Virginia.

5. COOK, M. G. and C. I. RICH. Virginia Polytechnic Institute. *Some Occurrences of Paragonite in the Wissahickon Schist of Virginia.* Paragonite in association with muscovite was found in four widely separated areas of the Wissahickon schist in Virginia. The presence of paragonite was substantiated by mean of x-ray diffraction and chemical analyses. Schist obtained from a site near Lynchburg had a relatively constant sodium: potassium molar ratio of 1:1 at various sampling depths down to 50 feet. The 1:1 molar ratio was maintained in the clay fraction of the soil overlying the schist, indicating that muscovite and paragonite weather similarly. The effect of particle size, within the limits 0.002 – 2 mm., on the sodium and potassium content was negligible. Boiling the micaceous schist in sodium and magnesium salt solutions resulted in the loss of sodium and potassium accompanied by swelling of the mica structure. The easy expansion was not characteristic of well crystallized muscovite; hence the structures of the micas investigated probably were quite different from specimen type muscovites. The apparent difference in weathering may be associated with the kind of clay minerals found in soils formed from the issahickon schist.

6. KATZ, ARTHUR S. University of Virginia *Comments on the Mineralogy at the Sulfur Mine, Mineral, Virginia.* The sulfur mine, 4 miles north of Mineral, Virginia, opened 1834 and the gossan mined through 1877. Iron was made in the Victoria furnace on the property. Pyrite was mined 1882-1920, when competition from native sulfur forced closure. Eleven shafts were sunk to a depth of 740 ft. The lensed ore bodies average 40-50 ft. in thickness and several hundred feet in length, strike N. 30° E., dip 60°, and conform to the enclosing schist which is chiefly micaceous and chloritic. The Sulfur Mine area is intensely mineralized. This study was undertaken to present detailed descriptions of the rocks and minerals, to verify and expand existing lists of minerals from the area. Minerals found to date are: native copper, pyrite, chalcopyrite, pyrrhotite, sphalerite, galena, quartz, hematite, martite, ilminite, spinel (gahnite), magnetite, goethite-limonite, calcite, siderite, ankerite, melanterite, un-named $\text{Fe SO}_4 \cdot 4 \text{ H}_2\text{O}$, copiapite, brochantite, kyanite, staurolite, garnet (almandite), epidote, clinozoisite, allanite, tourmaline (schorlomite), zircon, talc, biotite, muscovite, sericite, chlorite, chloritoid, and plagioclase feldspar.

7. NELSON, BRUCE W. Virginia Polytechnic Institute. *Interaction Between Industrial Effluent and Suspended Sediment at West Point, Virginia.* The *in situ* adsorption of lignaceous effluent by suspended inorganic solids in the Pamunkey and York Rivers near West Point, Virginia, is described. The paper mill effluent consists largely of large, complex organic molecules, many of which approach colloidal dimensions. The inorganic solids consist of clay minerals belonging to the illite, kaolinite, and vermiculite groups. At the point where the effluent is discharged into the Pamunkey River an interaction between the effluent molecules and the inorganic solids apparently takes place. Samples of the mixed effluent and river water with its naturally contained solids are cleared of the effluent when filtered on millipore filters. The filtered solids retain the organic effluent. Apparently the organic molecules are adsorbed by the silt. It is thought that the process of adsorption must take place in the river water whenever large concentrations of effluent exist in the presence of suspended solids of clay size. Laboratory experiments show that clay-organic complexes of 15 \AA° periodocity are formed when montmorillonite is exposed to the paper mill effluent. The adsorbed organic matter appears to be quantitatively retained when the complex is subject to various leaching treatments. The formation of clay-organic complexes by minerals other than montmorillonite is difficult to demonstrate. Other laboratory experiments show that when organic effluent and montmorillonite solids at concentrations similar to those existing in the Pamunkey River are mixed, a similar interaction as described for the natural systems is observed. In these cases about 10% of the organic material present is removed from solution and adsorbed on the clay after filtration.

8. ELLISON, ROBERT L. University of Virginia. *Linear Features in the Spring Hill Area, Augusta County, Virginia.* Analysis of 286 fracture traces, as mapped from aerial photographs of the Spring Hill area, shows that these fracture traces are preferentially oriented. North of the Staunton-Pulaski fault, two orientation maxima are evident: N. 60° W. to N. 70° W. and N. 10° W. to N. 20° W. Limited field checking has shown that the dikes in the area generally conform to the N. 60° W. to N. 70° W. orientation. South of the fault, one orientation maximum, at N. 40° W. to N. 50° W., is present. The disparity between fracture orientations north and south of the fault may be the result of slight rotation during faulting. Furthermore, fracture traces south of the fault are more densely disposed than those north of the fault. This fact, along with the unimodality of the orientation of the traces south of the fault contrasted with the bimodality north of the fault, may be related to the difference in rock types on either side of the fault.

9. GRIFFIN, V. S. University of Virginia. *Comments on the Structural Petrology of Some Cambrian and Precambrian Rocks of the Central Blue Ridge of Virginia.* A petrofabric investigation of the formations of the Chilhowee group of the Lower Cambrian, the Lynchburg formation of the Upper Precambrian and the Lovingston gneiss and Marshall formation of the basement complex, within the Blue Ridge of central Virginia, has been carried out. The investigation demonstrated an agreement between the orientation of the megascopic structures and the microscopic fabric of the Lower Cambrian and Lynchburg formations, and a disparity between the orientation of megascopic and microscopic fabric of the two units from the basement complex. The Lower Cambrian fabric agrees closely with the fabric of the Lynchburg formation, suggesting a similar tectonic history. The fabric of the basement complex is dissimilar to that of the younger rocks, and indicates a more complex orogenic past. Two possible causes for the origin of the initial quartz fabric are offered, namely, deformation alone, or sedimentation with subsequent deformation.

10. KASTER, D. L., W. J. MEYER and J. F. DERTING. Virginia Polytechnic Institute. *Field Observations of Solids Developed from Some Inconsolidated Deposits in the Piedmont Lowlands Province of Prince William County.* Soils containing loose subrounded cobbles and gravel, and their relationship to the underlying consolidated rock, were studied. These studies were made on and at the base of Bull Run Mountain and to the east in the Piedmont Lowlands. The area at the base of the mountain and the highest ridge crests to the east (where the bedrock is Triassic shale and sandstone) were found to be covered by a mantle. This relatively coarse mantle appears to be of mountain origin. It is suggested that a sizable portion of the Piedmont Lowlands was once mantled by mountain materials. The higher mantled ridge crests are remnants of

a once continuous mantle. Soils occupying lower relatively flat areas in the vicinity of the higher, mantled ridge crests contain a stone line in the lower horizons. The gravel forming this stone line appears to be another remnant of the higher lying, once continuous mantle. This remnant gravel apparently was later covered by material eroded from the exposed nearby Triassic shale and sandstone ridges. In time this material developed into soil. These conclusions are suggested by the characteristics of these soils, their position in the landscape, and the kinds of gravel forming the stone line in the lower soil horizons.

11. YOUNG, R. S. and D. K. GRUBS. University of Virginia. *Reconnaissance Magnetic Survey of Mole Hill, Rockingham County, Virginia.* Nine ground magnetic traverses, aggregating 34,700 feet, were completed over the Mole Hill intrusive, Rockingham County, Virginia. Published references describe the intrusive as a spinel-bearing olivine-bearing basalt in the form of a volcanic neck or plug. Vertical intensity data show that the igneous mass is dipolar, but complexly and unequally so. The positive pole is about 1,800 gammas above regional background ($Z = 53,660$ gammas); approximate values of 4800 and 5700 gammas are associated with the two negative centers. Maximum magnetic relief recorded is 7,482 gammas. The magnetic axis trends west-northwest. On the basis of magnetic profiles, dimensions of the outcropping basic body are estimated at 2,000 feet east-west and 1,200 feet north-south. An east-west strike, with subsurface extensions beyond outcrop limits, and a steep south dip are indicated. The strong negative nature of the Mole Hill anomaly cannot be explained entirely as polarization induced by the earth's present field. The conclusion is reached that this anomaly is due to remnant magnetization, the resultant of the present field and one of much different orientation existing when the rock was emplaced.

12. HALE, ROBIN C. Virginia Polytechnic Institute. *A Polymictic Conglomerate Along the New River, Giles County, Virginia.* A polymictic conglomerate, probably of Quaternary age, occurs at three localities along the southeast slope of Turnhole Knob 1.12 mile north of Bluff City, Giles County, Virginia. Most pebbles, cobbles, cobbles, and boulders in the conglomerate consists of sandstone, quartzite, siltstone, shale, and both black and oolitic chert. A few of the fragments were derived from the Blue Ridge crystallines, consisting predominantly of vein quartz pebbles. The conglomerate is poorly bedded although some stratification of fine-grained material occurs between zones characterized by a higher percentage of coarser material. The maximum thickness observed was 25 ft. The upper part of the deposit is marked by a terrace-like surface. The deposits owe their rusty-brown color to the ferruginous minerals which form a cement coating around the particles of the poorly lithified conglomerate. The conglomerate is very poorly sorted with sizes ranging

up to 4 x 2 ft. The predominantly tabular, rounded pebbles, cobbles, and boulders display a shingled or imbricate pattern. The larger material is marked by impact scars and some broken rounds are present, suggestive of high current velocities. The occurrence of these deposits at relatively uniform elevations indicates that they are remnants of an old elevated alluvial terrace of the New River.

13. WORKMAN, W. E. and E. K. RADER. University of Virginia. *Comments on Magnesium Sulfate Minerals Formed in Brooks Museum on Serpentine from Impruneta, Italy.* In August, 1959, a delicate white crust was found on a specimen of serpentine from Impruneta, Italy, deposited in the Brooks Museum, University of Virginia. The crust had originated through the action of sulfuric acid on the serpentine; the acid being derived from the decomposition of pyrite contained within the serpentine. The crust was identified by x-ray diffraction in the summer of 1959 as epsomite, $Mg SO_4 \cdot 7 H_2O$. In the winter of 1961, however, a powder photograph indicated that the substance had dehydrated to starkeyite, $Mg SO_4 \cdot 4 H_2O$. Using both crust material and commercially prepared epsomite crystals, 2 experiments were conducted to determine what conditions magnesium sulfate would gain or lose water. The dehydration experiment was conducted with an average relative humidity of 25%, and an average temperature of 26° C. Studies showed that after 24 hours the epsomite had dehydrated to hexahydrite, $Mg SO_4 \cdot 6 H_2O$, but after 5 weeks, x-ray photographs indicated that starkeyite was predominantly present. A hydration experiment was conducted with an average relative humidity of 56%, and an average temperature of 16° C. After 5 weeks a serpentine crust sample completely hydrated to epsomite. It thus seems feasible to reconsider the "rarity" of the recently discovered starkeyite in nature. In areas where there are significant seasonal changes in relative humidity, epsomite might dehydrate to starkeyite in winter months, and hydrate to epsomite in the summer.

SECTION OF MEDICAL SCIENCE

1. WOUDENBERG, T. J. and L. A. MOUNTER. Medical College of Virginia. *The Reaction of Hydrolytic Enzymes with Organophosphorus Compounds.* The titration curves of native alpha chymotrypsin (Cht), Di-n-butylphosphofluoridate tagged alpha chymotrypsin (DBP-Cht), and "reactivated" DBP alpha chymotrypsin (REACT DPB Cht) were compared. All enzymes originated from a common stock solution of 1% alpha chymotrypsin and shared an identical history with the exception of those reagents used for inhibition or reactivation of the enzyme. In all cases the enzyme preparations were exhaustively dialyzed against 0.001

N HCl prior to titration. The concentrations were equalized on the basis of protein nitrogen. The titration curve of DBP Cht showed a small but significant difference when compared to the Cht curve. A number of explanations for this difference were presented. We do not believe the DBP Cht curve reflects a major alteration to the alpha chymotrypsin molecule. The REACT DBP Cht curve exhibited a major divergence with respect to both native and inhibited enzymes. The extent of this divergence indicates either a major alteration to the chymotrypsin molecule or a mixture of chymotrypsin molecules and nondialyzable polypeptides. A more definitive statement requires analyses which are now in progress.

2. DIGGS, C. L. and J. F. ALBRIGHT. Medical College of Virginia. *An Immunochemical Analysis of Chymotrypsins.* Antisera were prepared using chymotrypsinogen, alpha-chymotrypsin, beta-chymotrypsin, and gamma-chymotrypsin as antigens. Two techniques were employed for the primary immunizations: (1) intraperitoneal administration of alum precipitated antigen and (2) foot pad administration of antigen in Freund's adjuvant. Utilizable quantities of antiserum were obtained in all cases. Qualitative precipitin tests revealed broad cross reactions in the non-homologous systems. Comparison of the zones of maximal precipitation indicated no major differences in the intensity of the serological reactions in the homologous as opposed to the non-homologous systems. Agar diffusion analyses also demonstrated no differences between the homologous and cross reacting systems. The reaction of identity (coalescent bands) was observed when the four antigens were compared using each of the antisera. Comparison of all antisera using each antigen gave the same result. Heterogeneity of all the antigens was demonstrated by incubation of the plates at 5-6° C. Under these conditions a second band appeared which was not observed at room temperature. Starch gel electrophoresis in acetate buffer at pH 4.6 and ionic strength 0.1 revealed no contaminating material. The presence of 0.001 M sodium ethylene diamino tetraacetate in no way affected the observations on the agar diffusion analyses or the qualitative precipitation tests. Quantitative precipitation tests were performed to compare native alpha-chymotrypsin with alpha-chymotrypsin in which the enzymatically active center is inhibited by treatment with di-n-butyl fluorophosphate (DBP-alpha-chymotrypsin). Rabbit anti-alpha-chymotrypsin gamma globulin was employed as the antibody. Protein estimations of the specific precipitates were made by use of Lowry's modification of the Folin phenol method. The resultant curves revealed no differences in the two reactions, suggesting that the active center does not participate in the serological reaction.

3. MOUNTER, L. A., H. G. WHITE, and H. A. WELLONS. Medical College of Virginia. *Fatty Acid Activation and Choline Ester Synthesis in Brain Tissue.* It is now known that the synthesis of acetylcholine from

choline and acetate by brain preparations *in vitro* requires the presence of catalytic amounts of coenzyme A (CoA) and adenosine triphosphate (ATP) and proceeds in two steps, (1) formation of acetyl-CoA from acetate and CoA by acetylkinase, (2) transfer of the acetyl groups from acetyl-CoA to choline by choline acetylase. There are, however, many sources of acetyl-CoA other than the acetylkinase reaction, and acetylase has been successfully coupled to a variety of acetyl-CoA donor systems *in vitro*. It has recently been shown that choline acetylase and acetylcholine exist in brain tissue in distinct subcellular particles (acetylcholine particles) which interpose a permeability barrier between these substances and their surroundings. It is not known whether these particles can draw freely on the brain's metabolic pool of acetyl-CoA, whence this principally arises or whether the particles manufacture their own acetyl-CoA from some preferred source. The studies to be described were designed to throw light on these equations. (Supported by NIH Grant CY 3652).

4. MOUNTER, L. A. Medical College of Virginia. *Problems in Enzyme Specificity.* Studies of enzymes specificity and kinetics have been extensive in recent years. Many enzymes have been characterized and in some instances steric factors which are involved in the formation of enzyme-substrate complexes have been well evaluated: the concept of a relation between enzyme and substrate which is very similar to the "lock and key" postulates of Bayer have been established. With the rapid expansion of structural investigations of proteins similarities in amino acid sequence and kinetic behavior have been demonstrated for many hydrolytic enzymes. As a result of these studies the concept of a fixed spatial arrangement of specific groups of an enzyme surface no longer appear to be adequate to explain the observed phenomena of specificity. Data will be presented regarding the specificity of several hydrolytic enzymes. X-irradiation of these enzymes is able to produce alterations in kinetic constants which can be interpreted as specificity changes. The significance of these observations will be discussed in relation to the mechanisms of interactions between enzymes and substrates. Investigation supported by NIH grant - CY 3652.

5. UPDIKE, IRA A., NITA S. RAWLES, and L. A. MOUNTER. Medical College of Virginia. *The Effect of Ionizing Radiation on Nucleotidases.* Considerable attention has been paid to the inactivation of biologically active materials by ionizing radiation. In the case of enzymes, investigations have usually been confined to the determination of residual activity after irradiation. A distinction must, however, be made between (a) the measured activity as related to turnover number and (b) the total number of catalytically active molecules present in a given amount of modified enzyme. If various techniques of measurement give the same values for the degree of inactivation, it would suggest that inactivation

is due to a complete loss of enzyme function in individual protein molecules; differences in results would indicate that it is possible to damage a molecule without concomitant loss of all enzymic function. An extension of studies made previously with proteases and esterases, the effect of x-irradiation of nucleotidases is now being studied. Kinetic measurements using RNA and cyclic nucleotide diphosphates as substrates indicate alterations in the enzyme which do not involve complete loss of function. Supported by NIH grant CY 3652 and A. D. Williams Fund, MCV.

6. HAM, WILLIAM T., JR., W. J. GEERAETS, H. A. MUELLER, R. C. WILLIAMS, M. E. TURNER, GUY CHAN, F. H. SCHMIDT, and R. S. RUFFIN. Medical College of Virginia. *Comparative Study of Aging and Ionizing Radiation on the Rabbit Lens.* The eyes of 120 rabbits, 8-10 weeks of age, received radiation doses of 0, 200, 600, 1000 rads from a 1 Mev x-ray machine. The x-ray dose was delivered either to the whole eye (15 mm. diam. beam) or to the central axis of the eye (3 mm. diam. beam). All animals receive a thorough slit lamp examination at time of irradiation and at 6 months intervals thereafter until sacrifice or death intervenes. The colony of 120 rabbits is divided into 6 groups according to an incomplete block arrangement designed statistically for maximum information. Animals are sacrificed, 4 at a time, at 6 months intervals until each of the 6 groups are depleted. The current status of physical studies involving the mass, volume, density, hardness, and light transmission of the lense are presented. To date, these studies demonstrate some well defined changes with age but no significant change with radiation dose. The slit lamp examinations show marked changes as a function of radiation dose and type of irradiation but little change with age. Supported under AEC Grant At-40-1, 5452, Code 3254-3621.

7. RUFFIN, R. S., R. C. WILLIAMS, F. H. SCHMIDT, and WILLIAM T. HAM, JR. Medical College of Virginia. *Physical Characteristics of High Irradiance Pulses.* Some of the physical characteristics of high irradiance pulses produced and timed electronically, in the range of 20 microseconds to 200 milliseconds were discussed. A technique which makes use of the Osram type XBO-2001 high pressure Xenon arc lamp has been developed for the study of retinal burns as one of the eye hazards of high altitude nuclear explosions. It was shown that the relative light output from these pulses rises fairly linearly with power input up to 300 kilowatts and still rises, although with less linearity to over 500 kilowatts. With the use of this system, fairly severe burns have been produced on the retina of the rabbit eye in less than 50 microseconds. Supported by grant no. DA-40-193-2080, Defense Atomic Support Agency.

8. BERRY, E. R., and R. C. WILLIAMS. Medical College of Virginia. *Titrimetric Analysis of Lens Protein.* The recording potentiometer

reported by R. C. Williams at the Virginia Academy of Science, May 1960, in Richmond has been tested and found to be a very stable and sensitive instrument. A variable titrant delivery system capable of delivery as slow as 2 microliters a minute has been perfected by Raymond S. Ruffin and has been used in this study. Titrimetric analysis is generally used in the characterization of isolated and purified biological materials, but it is also applicable to complex systems to study the change in concentration or chemical or physical alterations of components. The effect of ionizing radiation on the lens protein system of the rabbit has been demonstrated (see W. T. Ham, this program) by this technique. Whole lens (one eye irradiated, the opposite untreated) were surgically removed, ground with a mortar and pestle in 0.17 M KCl, and the mixture dialyzed against 0.17 MKCl for 48 hours. The concentrations (by protein nitrogen) were equalized and titrations performed. There is a characteristic titration "step" in the irradiated lens material at pH 6.5 which is not found in the corresponding control lens. This step is present in 1000 R treatment and also at 200 R. The limit of alteration will be determined and the correlation of ionizing radiation and age in respect to cataract formation evaluated. (Supported by AEC grant, AT-40-1, 2452, Code 3254-3621).

9. BORZELLECA, JOSEPH F. Medical College of Virginia. *Influence of Saline Infusions on the Course of Barbiturate Intoxication.* Since the demonstration from this laboratory that barbiturates are absorbed from the urinary bladder, attention has again been focused on the influence of the urinary tract in barbiturate intoxication. A survey of the literature revealed confusing data on the effects of diuresis on recovery from barbiturate depression. An attempt to resolve some of this confusion has resulted in the present study. The femoral veins of adult mongrel dogs were cannulated with polyethylene catheters. Various barbiturate solutions and 0.9% NaCl were infused through these catheters by means of infusion pumps. The respiratory arrest dose (R.A.D.) and cardiac arrest dose (C.A.D.) were determined. The infusion of barbital sodium, 5 mg/Kg/ml/min resulted in a R.A.D. of 675 and a C.A.D. of 700 mg/Kg. The administration of artificial respiration increased the C.A.D. to 1359 mg/Kg. When saline, at either 2.5 or 5.0 ml/Kg/min was infused in addition to administering artificial respiration, the C.A.D. was raised to 1513 mg/Kg. When acetazoleamide, 50 mg/Kg. i.v. was given in addition to the above, the C.A.D. rose to 1645 mg/Kg. With pentobarbital sodium, 1 mg/Kg/ml/min, the R.A.D. was 49 and C.A.D. was 51 mg/Kg. When artificial respiration was applied, the C.A.D. rose to 136 mg/Kg; with 2.5 ml/Kg/min of saline, the C.A.D. was further raised to 148 mg/Kg. These data confirm that artificial respiration is beneficial in the treatment of barbiturate depression and they further indicate that moderate diuresis in conjunction with respiratory support is more effective in over-

coming both pentobarbital and barbital induced depression. Supported in part by NIH Grant RG 7064.

10. GOURLEY, D. R. H. University of Virginia. *The Effect of Insulin on the Flux of Potassium in Isolated Frog Muscle.* Isolated intact sartorius muscles of the frog were placed in K-free Ringer's solution at 5° C for 18 hours to reduce their potassium content to about 70% of normal. During subsequent incubation at 20° C in Ringer's solution containing 10 mEq K/1, K influx > K efflux and the muscles regained their normal potassium content within about 100 minutes. During the recovery period K influx was measured with K⁴² and 50 m units/ml insulin had little or no effect on the rate of K influx. However, determination of the change in the K content of the muscles suggested that actually insulin inhibited K influx slightly during the first 60 minutes of the recovery period. This apparent inhibition disappeared later in the incubation period indicating an effect of insulin on K efflux. Potassium efflux was measured in a separate experiment by loading the muscle with K⁴² in a preliminary incubation and measuring the K⁴² that was released into non-radioactive Ringer's solution in subsequent 60-minute periods. Under these conditions 50 m units/ml insulin slowed the K efflux from 8.1% hr⁻¹ to 7.1% hr⁻¹ which approximately accounted for the increase in muscle potassium observed concomitantly. The effect of insulin of therefore the net result of inhibition of K efflux probably combined with a smaller inhibition of K influx by the hormone.

11. ABBOTT, LYNN D., JR. and SUSAN G. RUDOLPH. Medical College of Virginia. *Biochemical Studies in Experimental Porphyria.* Allylisopropylacetylcarbamide (Sedormid) produces in animals an experimental porphyria of the hepatic type similar to human acute intermittent porphyria. Porphobilinogen, uroporphyrin and coproporphyrin are excreted in large amounts. The mechanism of Sedormid-induced porphyria, and the metabolic lesion in human acute porphyria, are not known. We have made serial quantitative determinations of urinary excretion of *delta*-aminolevulinic acid (ALA), porphobilinogen (PBG), uroporphyrin and coproporphyrin during the development of porphyria by Sedormid administration in both rabbits and rats and have studied the effects of a number of amino acids on Sedormid-porphyria in rats. ALA excretion was found to be increased by Sedormid in both species, and the precursors (ALA and PBG) reached peak levels before the porphyrins. Glycine administration markedly increased ALA, PBG and uroporphyrin excretion; histidine or *beta*-alanine did not. The early appearance of precursors, including ALA, may be the result of an abnormal increase in hepatic ALA from increased synthesis or decreased catabolism by alternate pathways. Increased turnover into PBG and porphyrins might arise from excessive ALA accumulation.

12. HIGGINS, EDWIN S. Medical College of Virginia. *Mechanism*

of Action of the Enzyme Nitroaryl Reductase. Mycelia of *Aspergillus niger* contain an enzyme capable of linking the oxidation of reduced pyridine nucleotides to the reduction of nitroaryl compounds. Methods for the preparation and assay of this enzyme are described and Michaelis constants for electron donor and electron acceptor substrates for the enzyme are reported. The enzyme is particularly sensitive to p-chloromercuribenzoate and cupric ion and this inhibition is reversed by several thiols. The latter compounds increased enzyme activity, presumably by protection of enzyme sulfhydryl groups, since the thiols themselves were shown not to act as intermediate electron carriers. Use of metal binding agents, atabrine, sulfhydryl reagents, and redox dyes permitted the interpretation of the mechanism of action for the enzyme to be as follows: The electron donor substrate (DPNH) reacts with the enzyme at a sulfhydryl-sensitive site and electrons either directly to external electron acceptors (redox dyes) without the intervention of a metal component or, by way of a metal cofactor, to the terminal electron acceptor, dinitrobenzene. The enzyme was shown to be free of pyridine nucleotide-cytochrome reductase and nitrate reductase activities. Substrate specificity studies established that nitroaryl reductase is a new enzyme, unrelated to previously known metalloflavoproteins.

13. FORBES, J. C., P. D. CAMP, A. J. WASSERMAN, W. T. TUCKER, A. L. FORBES, and O. M. PETTERSON; Medical College of Virginia and Veterans Administration Hospital. *Effect of Centrifugation at 20,000 X g on Lipid Distribution of Human Sera.* The effects of centrifugation at 20,000 X g for 2 hours on the lipid distribution of various human sera have been studied. In general, when the neutral fat was below 176 mg per cent, very little, if any, cholesterol or phospholipids rose to the surface. When the neutral fat content was markedly elevated, as much as 90 per cent of both cholesterol and neutral fat and 50 per cent of phospholipids underwent flotation. However, subjects with similar degrees of marked hyperlipemia appeared to separate into 2 major groups represented by moderate and marked degrees of flotation of neutral fat, the later group being composed primarily of subjects with familial hyperlipemia. An inverse correlation was found between the whole serum neutral fat content and the percentage of the total cholesterol remaining in the subnatant serum. Variations from these general patterns and possible clinical interpretations are under study.

14. ACKERMAN, C. J., and V. TSOU; Virginia Polytechnic Institute. *The Physiological Effects of a new Thyroid hormone-like substance found in duodenal tissue.* A partially purified fraction has been prepared from hog duodenum, which contains no iodine and is clearly distinguishable from known thyroid hormones on paper chromatograms. It does not prevent goiter in the usual goiter prevention assay but stimulates growth of

goitrogen-fed rats and thyroidectomized rats. Growth of hypophysectomized rats is stimulated as determined by the width of the epiphyseal plate, when administered orally, but not when the substance is injected. The physiological effects resemble those of triiodothyronine.

15. SCHWARTZ, SORELL L., EDWARD R. BOWMAN, and HERBERT McKENNIS, JR. Medical College of Virginia. *Metabolism of (-)-Cotinine in the Rat.* The role of (-)-cotinine as an intermediate in the metabolism of (-)-nicotine has been established in many species, including the dog and the human (in this laboratory), and the rabbit (Hucker, Gillette and Brodie, *Nature*, 183, 47, 1959). Recent studies in the rat with (-)-nicotine-methyl-C¹⁴ have shown demethylation with appearance of significant quantities of radioactivity in the respiratory carbon dioxide. In the present studies the urine of male albino rats was examined for Koenig positive components after oral administration of (-)-cotinine. Paper chromatograms of the chloroform extract of the urine contained zones with Rf values corresponding to (-)-cotinine, hydroxycotinine-desmethylcotinine, and Y-(3-pyridyl)- β -oxo-N-methylbutyramide. Truhaut and de Clercq (Bull. Soc. Chim. Biol. 41, 1693, 1959) have reported the metabolism of nicotine to cotinine by the rat. The possibility arises, therefore, that carbon dioxide-C¹⁴ arises via demethylation of cotinine. The hydroxycotinine fraction, following acetylation, was chromatographed on alumina to yield acetoxycotinine which was isolated in the form of crystalline picrate. The results indicate that the metabolism of (-)-cotinine in the rat conforms, in part at least, to routes already established for the dog. Aided by grants from the Tobacco Industry Research Committee and the American Tobacco Company.

16. PROFFIT, WILLIAM R. Medical College of Virginia. *Autoradiography in the Study of Amino Acid Metabolism.* Autoradiography, the exposure of a photographic emulsion by its proximity to a source of radioactivity, allows very precise localization of artificially introduced radioactive material. The resolution of the autoradiograph depends in large part on the isotope which is used as the radioactive label: the lower the energy of the beta particle emitted, the greater the resolution which can be obtained. Labelling with tritium, which emits a very low energy beta particle, thus offers advantages for autoradiographic visualization. The maximum resolving power of the light microscope can be used to study tritium autoradiographs. Pregnant female albino rats were injected with 200 microcuries of tritium-labelled methionine intraperitoneally four hours before sacrifice. Maternal and fetal tissues were taken for stripping-film autoradiography; after 28 days exposure, areas of concentration were evaluated by grain counting under oil immersion. Preliminary results indicate high concentration of the labelled methionine in at least three areas: 1) secretary epithelium of the intestine, 2) mucous glands of the

respiratory tract (perhaps mucous glands in general), 3) keratinizing oral epithelium. Considerably less radioactivity appears in other maternal tissues; only small amounts seem to reach the fetus, where there are no areas of high concentration. Supported by grants DT-8 and A-1390 of the National Institutes of Health.

17. ALLAN L. FORBES, Medical College of Virginia, BERTRAM D. DITMAN, Ohio State University, and JEFFREY H. FRYER, Cornell University. *Clinical Aspects of a Nutrition Survey of the Kingdom of Thailand*. From October through December of 1960, a survey of the nutritional status of civilians and military forces was conducted in Thailand under the auspices of the U. S. Interdepartmental Committee on Nutrition for National Defense. The survey encompassed clinical, dental, biochemical, dietary, and food technological aspects in 7 widely scattered areas throughout the country. Clinical examinations were performed on 2,389 civilians of all age groups in 12 villages and on 4,325 military personnel. Among adult civilians, the average male weight was 112 lbs. and height 63 inches; the average female weight was 96 lbs. and height 59 inches. Goiter was the most prevalent finding in general, involving as high as 65% of specific village populations, attaining 100% prevalence in pregnant and lactating women in some communities. Angular lesions were widespread, the highest incidence for a specific village being 12.3%. Filiform papillary atrophy was observed throughout the country, the highest village prevalence being 8.4%. Loss of deep tendon reflexes (national average of 1.4%) and frank beriberi were infrequently observed during the survey. Various manifestations of periodontal disease and fluorosis were very common. In general, the prevalences of nutritional lesions among the military personnel were similar to those observed among adult civilian males.

18. GROSS, W. B. Virginia Polytechnic Institute. *Bacterial Endocarditis of Chickens and Turkeys*. From chickens or turkeys naturally infected with bacterial endocarditis isolates of *Staphylococcus aureus* and *Streptococcus fecalis* were made. Three additional strains of *Streptococcus fecalis* were isolated from the feces of apparently normal birds. All of these strains produced endocarditis in chickens or turkeys only following intravenous inoculation. Death from endocarditis usually occurred between 5 and 10 days after inoculation, with some birds surviving for as long as 31 days. No birds with endocarditis recovered. The lesions were vegetations on the mitral aortic and right auricular-ventricular valve. Septic thrombi often resulted in infarcts of the myocardium, liver or spleen. The microscopic pathology of these lesions has been extensively studied. At intervals after inoculation blood culture, differential and total leucocyte counts and blood chemistry determinations were made. Body temperatures were recorded from 49 birds at 3 minute intervals. Fourteen of these birds which developed endocarditis had temperature rises particu-

larly late in the disease. Birds which resisted infection maintained normal temperatures. While all of the determinations helped to detect birds with heart lesions the results of several determinations were usually necessary to make a definite diagnosis. Recently, examinations have included the use of an electrocardiogram and heart sounds have been recorded.

19. JOHNSON, HERMAN L. and RUSSELL F. MILLER. Virginia Polytechnic Institute. *The Effect of Dietary Molybdenum upon the Enzyme Bone Alkaline Phosphatase.* Male weanling Sprague-Dawley rats (housed individually in stainless steel wire-floored cages) were fed toxic concentrations of molybdenum in a purified low-protein diet. A marked growth depression was noted when feeding the diet supplemented with 600 ppm molybdenum. Feeding 600 ppm molybdenum for 10 to 17 days resulted in a significant depression in femur alkaline phosphatase activity, and this depression was evident up to eight weeks of molybdenum feeding. When supplementary inorganic sulfate, 500 ppm, was fed with the molybdenum, a smaller diminution of growth and no depression in enzyme activity were noted. Added dietary copper, up to 50 ppm, did not affect either weight gain or enzyme activity whether molybdenum was fed or not. It appeared as if the depression in enzyme activity was a result of the generally poor growth and condition of the molybdenum-fed rat and was not due to molybdenum *per se*. Data from one study indicated that molybdenum *per se* exerted an influence upon the utilization of nutrients; however, it has not been determined whether the molybdenum interfered with digestion, absorption, or some other metabolic events.

20. RIFKIN, R. J. and RUSSELL F. MILLER. Virginia Polytechnic Institute. *Attempts to Obtain an Enzyme (Cysteine Oxidase) from Rat Skin.* The isolation of a purported enzyme system "Cysteine Oxidase" from rat skin homogenate has been attempted. The enzyme like system isolated from sheep skin reported in the literature contains copper, which is necessary for activation. This system utilizes cysteine as substrate. Hair-free rat skins were finely minced into .066 M phosphate buffer pH 7.0, and were homogenized in a VirTis Tissue Homogenizer. The optimum ratio of skin to buffer was found to be 1:2. A cell-free supernatant was obtained by centrifugation in the cold. This was used in the manometric assay for activity. Copper in catalytic amounts, (.0008-.0065 μ M/flask), when added to substrate in the absence of protein resulted in the destruction of substrate. Rat skin supernatant incubated in the presence of substrate showed increased oxygen uptake, when compared to substrate plus copper in amounts equal to that present in the supernatant. The oxygen uptake of dialyzed supernatant preparations in the presence of substrate, when compared to substrate plus equal copper were similar. The unequivocal assessment of enzymatic function cannot as yet be ascribed to this program.

21. GEMMILL, C. L. and K. M. BROWNING. University of Virginia. *The Effects of Iodinated Salicylates on Metabolism.* Various amounts of salicylate, 5-iodo-salicylate and 3,5-diiodo-salicylate were injected into normal, thyroidectomized, and into rats made hypermetabolic by placing 3,3',5-triiodothyronine in drinking water. The oxygen consumptions, rectal temperatures and pulse rates of these animals were determined. It was found that salicylate increased the metabolism of the normal and hypermetabolic rats but not the thyroidectomized animals. 5-iodo-salicylate increased the metabolism in the three groups. 3,5-diiodo-salicylate decreased the metabolism in the normal and hypo animals. The dosage of salicylate varied from 12.5 mgm. to 30.3 mgm. per 100 grams body weight, 5-iodo-salicylate from 8.4 mgm. to 20.6 mgm. per 100 grams of body weight and 3,5-diiodo-salicylate from 1.0 mgm. to 20.6 mgm. per 100 grams body weight. Results with 5-bromo-salicylate were comparable to those obtained with 5-iodo-salicylate. The effects of these compounds on rectal temperatures and pulse rates will be reported later.

22. HOCH-LIGETI, CORNELIA. Veterans Administration Center, Martinsburg, West Virginia. *Effect of X-Ray Treatment on the Serum Lactic Dehydrogenase Level of Patients with Malignant Tumors.* The serum lactic dehydrogenase (LDH) is consistently elevated in patients with malignant disease. On X-ray treatment with 200 r daily tumor dose (3600 r total; 250 KV, Thorius 3 filter) the serum LDH decreased progressively after a lag of 4 to 5 days. In several cases normal levels were attained after 20 to 25 days. In some instances, however, the serum LDH returned to the pre-irradiation levels while radiation treatment was still in progress, and always on cessation of treatment. In patients undergoing surgical removal of a malignant tumor, the serum LDH increased slightly for a few days after operation; no decrease below the pre-operative level was found during the following weeks. It seems, therefore, that the decrease in serum LDH during X-ray treatment is not a consequence of a diminution of the tumor mass, but that it might represent a direct effect of X-rays on the tissue metabolism of the patient or on the enzyme system investigated.

23. BRAND, EUGENE D. University of Virginia. *Characterization of hemorrhagic hypotensive irreversible shock in the cat.* Hemorrhagic hypotensive irreversible shock was produced in 20 cats by an arterial reservoir maintained at 40 mm Hg for 2 hours and then at 45 mm Hg for 3 more hours. Reinfusion of the remaining shed blood led to a normal arterial blood pressure (BP) which immediately began to fall along a straight course ending in death from respiratory arrest at BP about 31 mm Hg after an average of 17.6 hours. Variables which show abnormality during hypotension, slight or incomplete recovery following reinfusion, and progression of dysfunction starting before the BP has fallen below

100 mm Hg include functions related to metabolism (rectal temperature, respiratory rate and blood pH), the heart (EKG and heart rate), the peripheral vascular system (low venous pressure) and the central nervous system (EEG amplitude and withdrawal reflex activity).

PSYCHOLOGY SECTION

1. ADAMS, HENRY B. and G. DAVID COOPER. Virginia Hospital, Richmond, Virginia. *Overt Behavioral Correlates of the Klopfer Rorschach Prognostic Rating Scale: a Validity Study.* Klopfer's Rorschach Prognostic Rating Scale (PRS) has been found by research workers to be a more sensitive instrument for measuring personality characteristics than the so-called "traditional" methods of Rorschach analysis. In the PRS, various categories of responses to the Rorschach ink blots are differentially weighted and combined into six component scores and a total prognostic score, the specific weights and combinations having been developed on the basis of both theoretical considerations and extensive clinical experiences with the Rorschach. The PRS is described as useful for differentiating the most important components of ego strength, i.e., reality testing, emotional integration, self-realization, and mastery of reality situations. The authors have conducted an empirical validity study, correlating the component and total scores with behavioral ratings of 39 hospitalized psychiatric patients. The behavioral ratings were made using the 20-item Symptom Rating Scale developed by the VA Psychiatric Evaluation Project. A total of 140 correlations were run. The number of statistically significant correlations was 2 1/2 times what would have been expected by chance alone. The patterns of correlations indicate that different component scores measure discrete aspects of personality functioning which are not reflected in the total PRS scores. The results unquestionably demonstrate the sensitivity of the Rorschach to underlying personality variables.

2. ADAMS, HENRY B. and G. DAVID COOPER. VA Hospital, Richmond, Virginia. *The relationship of Rorschach productivity to overt psychiatric symptomatology: a test of Phillips and Smith's hypothesis.* The Rorschach was administered to 39 white male veteran NP patients hospitalized for functional psychiatric disorders. These subjects were also interviewed and their interview behavior rated on each of the 20 items of the Symptom Rating Scale developed for the VA Psychiatric Evaluation Project. More severe total pathology was associated ($r = -.34$, $p < .05$) with lower Rorschach productivity. Consistent with the above finding, 17 of the 20 rating scale items were negatively correlated with R, indicating less productivity in subjects with more severe symptoms. Four correlations between individual scale items and Rorschach productivity were large enough to be statistically significant. Lower productivity was asso-

ciated with overt symptoms of memory deficit, uncooperativeness, evasion and guardedness, and apathy, as Phillips and Smith imply.

3. BORGHI, JOHN H. College of William and Mary. *Ego Threat and Noxious Stimulation as a Means of Inducing the Inhibition of Associative Recall.* An inhibition of associative recall was observed for responses followed by a raucous buzzer alone and for ego-threat alone, but no inhibition was found for responses followed by both variables. One-hundred Ss were asked to respond to 100 Kent-Rosanoff words. Twenty-five Ss were buzzed for certain "critical" responses, 25 both buzzed and threatened served as a control group. Following the administration of a 15 minute neutral task, Ss were asked to recall all 100 associative responses. There was significantly less recall of "critical" words for Ss either buzzed or threatened when compared with the control group. However, Ss both buzzed and threatened made the same number of errors on "critical" words as the controls. It was suggested that Ss either buzzed or threatened on "critical" words initially responded with a conditioned fear which generalized to thinking about the word. The inhibition found on recall was interpreted as the reduction of a learned fear drive. For Ss both buzzed and threatened it was hypothesized that a discriminative emphasis variable intensified the "critical" words tending to neutralize the effects of this compound variable. Testing of the hypothesis by systematically increasing and decreasing the independent variables of noxious stimulation and ego-threat was suggested.

4. BROMLEIGH, READ. College of William and Mary. *Effect of Letter-symmetry on Distribution of Errors in Tachistoscopic Letter-targets.* This experiment investigates the effect of directionality within a letter-target, produced by the inclusion of asymmetrical letters, on the accuracy in perception of letters placed to the right and left of fixation. The present hypothesis is that, even with tachistoscopic exposure, there is a sequential scanning of the letters beginning at one end of the pattern. On the basis of several assumptions, it was predicted that there will be (a) fewer errors for stimuli to the left of fixation; and (b) an obtained difference will be greater for asymmetrical than for symmetrical letters. The data support both predictions.

5. BROWN, JAMES H. University of Virginia. *The Role of Frequency and Similarity in the Perception of Visual Forms.* This study reports an investigation of the influence of two frequency variables (absolute and relative) upon the recognition and identification of stimulus forms rendered ambiguous by varying similarity. Evidence was sought as to whether the two perceptual responses (recognition and identification) are influenced in the same or different manner by the frequency and similarity variables. The resulting error scores indicated that the similarity scale utilized led to ambiguity in the manner anticipated, and the biphasic per-

ceptual response employed was sensitive to the experimental variables. The influence of the relative frequency variable was contrary to that expected, since subjects tended to identify the ambiguous test forms as those which had occurred most rarely during training, and not as those presented most frequently. These results clearly call for further investigation to clarify the findings and to verify the unusual role of frequency of stimulus occurrence suggested by this study.

6. BROWN, SAM C. University of Virginia. *Sources of Interference in Verbal Paired-associate Learning.* Paired-associate learning of a ten-item list was compared under conditions with zero, two, or four of the pairs appearing in the same serial position on every trial, while the remaining pairs were presented in a different serial position on each successive trial. Contrary to expectation, fewest errors were made under the zero-constant pairs condition, which corresponds to the standard procedure usually employed in paired-associate learning experiments. Number of errors increased significantly as number of pairs held constant in serial position increased from two to four, indicating that partial serial-position constancy interferes with rather than facilitates paired-associate learning.

7. CAMP, DAVID S. College of William and Mary. *Comparison of Simultaneous and Successive Tachistoscopic Presentation of Binary Patterns.* Ten-element horizontal patterns of open and blackened circles were tachistoscopically exposed such that zero to ten elements appeared on the left of a fixation point. Exp. I employed for reproduction of the patterns response templates consisting of ten blank circles and no reproduction of the fixation point. Fewest errors generally appeared for elements at the left within the target regardless of fixation locus. In Exp. II the response template consisted of 20 blank circles with a mark representing the fixation point between the tenth and eleventh circles. Fewest errors generally appeared for the elements closest to the fixation point.

8. DYER, DOROTHY W. and E. RAE HARCUM. College of William and Mary. *Error-contours for Binary Patterns as a Function of Practice.* Patterns of eight open and blackened circles were tachistoscopically exposed across fixation to 11 Os for a total of 3600 observations per O. Previous results had suggested the hypothesis that the superiority of the stimuli appearing to the left of fixation is decreased with practice. Contrary to the hypothesis, the difference favoring the stimuli in the left visual field is not changed after practice, although the overall decrease in errors magnifies the relative differential in errors after practice. Procedural differences between the present study and the previous study, which might account for the differences in results, are discussed.

9. FRIEDMAN, STEPHEN M. College of William and Mary. *Effects of Spatial-temporal Sequences in Visual Presentation of Binary Pat-*

terns. This study determines the effects on reproduction of binary visual patterns of presenting the elements of the pattern in Right-to-left, Left-to-right, or Random sequences, or of presenting them simultaneously. Twenty-seven Os were shown ten-element patterns. The prediction that most Os would exhibit fewer errors for stimuli to the left of fixation relative to the right of fixation was confirmed. Two other predictions were: orderly sequential presentation of elements would be superior to a random order of presentation; and orderly sequential presentation would produce superior performance. Results were opposite in direction from both predictions.

10. HARCUM, E. RAE and ROSEMARY HARTMAN. College of William and Mary. *A Serial-learning Effect within the Perceptual Span.* Eighteen Os reproduced tachistoscopic linear patterns of eight open or filled circles. The errors-function for elements, counted in order from left to right, in previous studies appears to be somewhat like the serial-position curve of rote learning. If these two tasks involve similar mechanisms, the perceptual-span function should be altered by isolating elements as the rote-learning function is altered by element-isolation. The isolation techniques used did not produce a significant effect. However, when a "sensitivity" function is subtracted from the overall error-curve, the remaining function is almost identical to the classical serial position curve.

11. JARRARD, LEONARD E. Washington and Lee University. *The Effects of Suggestion and of eBnzedrine and Meprobamate on Motor Performance.* This study was designed to determine the effects on motor performance of bexzedrine and meprobamate, and the suggestion of how these drugs affect motor performance of male students. An inspection of the means for simple reaction time, disjunctive reaction time, and pursuit rotor performance indicated a lack of any differences for the main effects or their interactions. There was improvement in performance over time but again, inspection of the means for the various groups did not suggest any differential improvement. Because of the similarity of the means for the various groups, no statistical analysis of the data was performed. There are a number of possible explanations for the lack of any differences in performance due to the administration of the various drugs and suggestions. In addition to the obvious possibility that the manipulated variables had no effects, certain uncontrolled variables could have influenced the results. Such things as inconsistencies in test administration by the different Es, knowledge of the purpose of the experiment on the part of Ss, and other uncontrolled variables could have been operating.

12. JOHNSON, R. B. Univrsity of Virginia. *The Effect of Logical Grouping on Performance in a Short-term Retention Task.* Organization in retention was investigated as a variable influencing performance in a short-term retention task. Subjects were required to remember familiar

English words until their recall was requested. Letterword pairs, e.g., *B-LARK*, *H-SHIRT*, etc., were presented aurally at a 2-sec. rate. Presentation and recall of letter-word pairs were not discretely separated, and storage and recall of the letter-word pairs were done concurrently by the subject in intervals as short as 4-sec. and as long as 25-30 sec. It was demonstrated that if the letter-word pairs could be grouped by the subject in terms of "natural" classes, e.g., *B-ELM*, *B-OAK*, etc., retention performance was greatly facilitated. In contrast, it was also shown that if there was no possibility to group related items, e.g., *B-ELM*, *B-TENNIS*, *H-FORDHAM*, *H-SHIRT*, etc. subjects made very little improvement in retention performance even over 8 experimental sessions. There was a total of 4 experimental conditions which varied from *maximal* to *none* along a continuum of "possibility-to-group" related items. In all conditions it was demonstrated that recall errors systematically increased as the opportunity to group related items varied from *maximum* to *none*. A practical significance for these results was pointed out.

13. JOHNSTON, ROBERT A. and HERBERT J. CROSS. University of Richmond. *A Further Investigation of the Relationship between Anxiety and Digit Symbol Performance.* The present study manipulated the difficulty level of the DST of the Wechsler tests to further investigate the relationship between MAS scores of DST performance. The Ss were General Psychology students at the University of Richmond selected from a larger group of 109 students on the basis of their extreme MAS scores. SCAT Total Scores and measures of copying speed were also available on all Ss. Ten low A Ss were assigned to each of three experimental groups. The difficult task group was taught incorrect symbols. The third group served as a control. The results confirmed earlier findings of a lack of relationship between MAS scores and DST performance, regardless of the difficulty level of the task. MAS scores were found to be positively related to copying speed scores. The fact that copying speed accounts for such a small segment of DST variance may explain the lack of relationship between MA Scores and DST performance.

14. MACPHERSON, DOUGLAS H. University of Virginia. *The Role of Direct Social Interaction upon Learning in a Minimal Social Situation.* The minimal social situation rests on the hypothesis that the major factors controlling social behavior are reward and punishment. In the minimal social situation 2 subjects are able to reinforce each other by pressing buttons which advance the other subject's reward counter or shock the other subject. The present study investigated the role of non-social factors in the minimal social situation, and concluded that a significant portion of the learning can be attributed to these factors.

15. MANTZ, PATSY. College of William and Mary. *A Study in Overcoming Boredom and Fatigue in a Monotonous Task.* This study

is an attempt to overcome boredom and fatigue in a repetitive, monotonous task by verbal methods. The three methods used were praise, reproof, and general conversation. The task was a massed practice trial, lasting 52 minutes, on a pursuit rotor. First, the time when boredom and fatigue were the greatest was established. Then each successive subject was assigned to a group and the appropriate variable was administered during the crucial time. It was found that general conversation has a slight effect, though not a statistically significant one. Both praise and reproof produce a significant increase in performance, with praise being the more effective of the two.

16. MCCOY, FRED and PEACHEE, CHARLES A., Jr. Mobile Psychiatric Clinic. *Validity of the Revised Beta.* IQ's obtained by the Revised Army Beta and appropriate Wechslers were compared for 96 adolescents. Factors of age, intelligence level, sex, and race were also examined.

17. SCHULIST, RICHARD S. Washington and Lee University. *The Effects of the Color of Numbers and Backgrounds on the Perception of Tachistoscopically Presented Numbers.* A two-way analysis of variance revealed that the color of blue was significantly better than the other colors as a background for the white numbers. Green was less desirable than blue but was significantly better than red or gray which were about equal. The yellow background was the poorest of all colors presented. Analysis of the numbers showed that 6 and 9 were similar in perceptability but significantly better than 5 or 8 which were also nearly equal. The number 3 was considerably less perceptible than the other numbers employed. It is felt that the results of this experiment might be beneficial to the field of advertising or other related areas. For example, displays with moving components might, perhaps, be more perceptible against a blue background even when all background colors considered are of equal contrast. Products with numerical names might make use of 6 or 9 which are more easily seen than 5, 8, or the number 3 which appears to be quite easily confused.

18. SMITH, NELSON F. College of William and Mary. *Some Effects of Three Dosages of Alcohol on the Anticipatory Response in Rats.* The purpose of this study was to investigate the effects of three dosages of alcohol on several levels of behavior during the acquisition of a task. The apparatus used was an alley maze divided by choice points into four sections. This arrangement allowed the measurement of motor performance, learning, and goal pointing errors. It was found that ethyl alcohol depressed running speed and anticipatory errors, but did not significantly affect the learning of the task.

19. MHITEHEAD, CLARENCE M., JR. Washington and Lee University. *The Counterbalancing Effects of Two Antagonistic Drugs as De-*

terminated by Bar-pressing and Activity in the Rat. Due to the small populations, no statistical analysis was applied. In the Sidman procedure, inspection of the number of shocks, bar presses, and cumulative curves indicated no carry-over effects from the drugs to the following day. Also, the activity results showed no carry-over effects. In the Sidman procedure, the overall effect of the two drugs (LSD-25 and methaminodiazepoxide) together showed less pressing and a greater number of shocks than when each drug given separately but as dosage of LSD-25 was increased both rats' data showed decreasing rate of pressing and an increasing number of shocks. In the activity wheel, it appears that performance was more affected by drugs given singularly than in the Sidman procedure. However, in the activity situation, increasing amounts of LSD-25 did not result in decreased activity beyond the decrease caused by the single drugs as in the Sidman avoidance performance. From the results obtained, it is obvious that there was no suggestion of antagonistic effects between the two drugs. The small animal population, unfavorable environment, lack of a large number of dosages over a wide range, and short training period left much to be desired but this study should serve as a good pilot for a later study as interesting facts were obtained as outlined above.

20. WILSON, MAURICE E. College of William and Mary. *Reversal of Strong and Weak Bar Press Habits Under High and Low Drives.* The postulated dynamogenic aspect of drive leads to the prediction that in habit reversal subjects under high drive will emit more incorrect responses before the first correct response than will subjects under low drive. After reversal is complete, the same subjects should make more correct responses in a given period of time. The present study is a test of these hypotheses. Twenty-nine rats were given 15 reinforcements of pressing a bar on one end of a modified Skinner box and 60 reinforcements of pressing a bar on the other end. All Ss were 24 hours hungry. The animals were then presented with both bars at the same time. At this time, only the bar on which the 15 responses had been given brought reinforcement. One group was 24 hours hungry; another was 24 hours hungry and was shocked before being placed in the box; a third was 48 hours hungry. The attempted manipulation of drive had no significant effect on habit reversal. These reversal tasks seem to have been greatly oversimplified by those who have tried to predict the effects of drive on them.

21. WOODS, JAMES H. University of Virginia. *Performance as Jointly Determined by Concentration of Sucrose and Duration of Feed Deprivation.* Concentration of sucrose and duration of food deprivation were combined factorially to assess their effects on one minute variable interval bar pressing. Concentration, either 4, 8, 16, or 32 per cent sucrose, represented the between groups variable and deprivation, either 0, 12, 24,

or 48 hours, was the within groups variable. The main effects and the interaction between concentration and deprivation were statistically significant at the .001 level by analysis of variance. The nature of the interrelation suggested that increases in deprivation produced greater increments in responding for increasing sucrose concentrations, while the longer deprivations at lower concentrations produced no increases in responding.

SECTION OF STATISTICS

Friday, May 12; Saturday, May 13, 1961, Mallory Hall. Introductory remarks: Chairman J. Armstrong, Jr. The following officers were elected or continued in office: Elizabeth Angle, Chairman; John M. Long, Vice Chairman; Rudolf J. Freund, Secretary; Clyde Y. Kramer, Section Editor.

MINUTES OF THE PROCEEDINGS

1. TAYLOR, R. J. Virginia Polytechnic Institute. *Sequential Allocation of Patients in Clinical Trials.* This paper describes a scheme for sequentially altering the proportion of patients assigned to various treatments of a clinical trial according to results obtained as the trial proceeds. Best treatments are, by this means, allocated a higher proportion of patients than inferior ones. This alteration of proportion is performed by use of a weighting function, several alternative forms of which are given. A simulation study of the efficacy of the procedure with regard to its ability to select correctly the best treatment is reported. Results indicate that, with use of appropriate weighting functions, this procedure is better able to select the best treatment than an equal allocation trial using the same number of patients. This comparison was made on the basis of Sobel and Huyett's (1957) study of three equal allocation case. The study shows that the weighting functions which are most efficacious in correctly selecting the best treatment are the ones that tend to assign the largest proportion of patients to the best treatment. A theoretical study of these statistics in special situations is also discussed.

2. EWALS, A. TIMOTHY. Medical College of Virginia. *The Iterated Gamma Distribution.* A derivation of the iterated gamma distribution is presented and is shown to lead to a Pearson Type VI distribution. Use of this distribution in discussing the errors in straight line regression problems with zero intercept is to be presented. Maximum likelihood estimates and asymptotic confidence limits are given.

3. ANGLETON, GEORGE M. Medical College of Virginia. *Modification of the Enzyme Substrate Interactions of the Enzyme Acetylcholinester-*

terase. Reduction of activity of an enzyme preparation may be interpreted in terms of alterations of the structure of the individual enzyme molecules, resulting in a modification of the interactions between enzyme and substrate molecules. The feasibility of using the parameters of a mathematical model to characterize the interaction of irradiated and non-irradiated acetylcholinesterase with the substrates acetylcholine chloride and acetyl-beta-methyl choline chloride is discussed. Interpretation of the results applicable to other enzyme systems is presented.

4. HORNER, THEODORE W. (Allen Applied Research, Inc.), GEORGE F. SPRAGUE (U. S. Department of Agriculture) and W. A. RUSSELL (Iowa State College). *Some Additional Procedures for the Detection of Epistasis.* Most procedures which have been developed for detection of epistasis are based on variance comparisons. This paper develops a basis for the use of 2 contrasts among means for epistasis detection. The first is the contrast of the mean of the three single crosses utilizing the same 3 inbred lines. The second is the contrast of the 3-way cross with the mean of the 2 single crosses used as a prediction of the 3-way cross. It is demonstrated that the 2 contrasts are zero in absence of epistasis and non-zero in the presence of certain types of epistasis. The contrasts were utilized in an examination of corn data.

5. DAVID, H. A. Virginia Polytechnic Institute. *Probabtilty Models for Choice Behavior.* Choice behavior is deterministic only in the simplest situations. Probability models are, therefore, of interest and have been studied by psychologists, sociologists and economists as well as statisticians. In this paper, models making increasingly strong statements about choice behavior are discussed for choices made by paired comaprison. Extensions to multiple choice and ranking situations are considered.

6. THIGPEN, CHARLES C.; Virginia Polytechnic Institute. *Distribution of the Maximum of Equicorrelated Normal Variables.* Statistics based on extremes of equally correlated normal variables with common variance are increasingly being suggested for various statistical procedures.

For the case of positive correlation and known variance Stuart takes the following device: Let

$$y_j = x_j - at, \quad j = 1, 2, \dots, N,$$

where the x 's and t are jointly independent, standard normal variables. Then the y_j are equally correlated with correlation $a^2/(1 + a^2)$, and the distribution function of $\max y_j$ may easily be written in terms of a single integral. This device can be extended to the largest absolute value, since

$$|y_j| < h, \quad j = 1, 2, \dots, N,$$

is equivalent to

$$at - h < x_j < at + h, \quad j = 1, 2, \dots, N.$$

If we now take

$$y_j = x_j - \bar{x} - at, \quad j = 1, 2, \dots, N,$$

the y_j are equally correlated with the correlation coefficient defined in terms of a in such a way that it may range over all allowable values, and the cumulants of $\max y_j$ may be defined in terms of those of $\max x_j$. The distribution of $\max y_j$ is thus hung onto that of $\max (x_j - \bar{x})$ for which McKay has given a difference-differential equation and for which Nair has tabulated the probability integral. Using McKay's result a difference-differential equation is derived for the distribution function of the maximum of equally correlated, standard normal variables.

7. BARGMANN, R. E. Virginia Polytechnic Institute. *Problems in the Construction of Statistical Computer Programs*. This report deals with problems encountered in the development of IBM 650 programs at the Virginia Polytechnic Institute. Programs which have been used extensively are: a general incomplete beta program; programs for Pearsonian system; non-central X^2 ; rotation in factor analysis; modification and application of matrix interpretive routines; bioassay routines; tailor-made programs for large studies, illustrated by the example of a study on mentally retarded children. Descriptions of problems which require construction of these specialized programs, and some of the limitations encountered and modifications needed for particular situations will be discussed.

8. CLODIUS, FREDERIC C. U. S. Naval Weapons Laboratory. *Automatic Generation of Pseudo-Random Numbers*. Several methods of generating pseudo-random numbers with the Bendix G-15D Computer have been devised. Since these methods cannot be used with the Intercom 1000 interpretive program, an easier method was devised for generating pseudo-random numbers which utilizes the Intercom 1000.

While working with the middle-of-the-square method for generating pseudo-random numbers as devised by Von Newman, it was obvious that an error was introduced by the computer. When the number is being shifted by the computer to extract the middle-of-the-square from a number a rounding error is caused. This is due to the rounding error in transforming from the binary system for computing to the decimal system for the type out. This rounding error is utilized to generate pseudo-random numbers; e.g., numbers that have the characteristics of random numbers, mainly independence of selection and uniform frequency distribution. The run test, the chi square test, and the serial correlation test were used to test the generated numbers for randomness. The average value of the pseudo-random numbers was also calculated and computed with the expected mean of .5. The numbers are rejected as being pseudo-random when any one of the tests rejected the numbers at the .05 level of significance.

9. HURST, DAVID C. Virginia Polytechnic Institute. *A Demand*

Analysis Problem with Non-Linear Aspects. The problem is basically the estimation of the parameters of a distributed lag demand equation of the form:

$$E(Y_t) = \beta_0 + \beta_1 P_t^*$$

where E is the symbol for expected value, Y_t is the quantity demanded at time t and β_0, β_1 are coefficients of the linear demand equation. If we have a constraint connecting the expected price P_t^* with the actual price P_t of the form:

$$P_t^* - P_{t-1}^* = Y(P_t - P_{t-\gamma}^*)$$

where $0 < Y < 1$, then

$$P_t^* = \sum_{i=0}^{\infty} Y(1-Y)^i P_{t-i}$$

and substituting this into the demand equation gives us a complicated non-linear equation in the parameters. It is proposed that a reasonable simplifying assumption on the time trend of pieces can enable the parameters B, B and Y to be estimated quite easily. Then if desired further improvement in the non-linear case can be obtained using these estimates as starting approximations with an iterative Newton procedure for obtaining the final estimates.

10. FREUND, R. J. Virginia Polytechnic Institute. *Some Comments on Computer Science.* The rapid growth of the use of high speed computers has created in many colleges a hodge-podge of courses which purport to teach students something about computing. This is the state in which statistics was about ten or fifteen years ago, and there are indications that the field of computing science may become an independent discipline just as statistics has done in recent years.

11. MADISON, WALKER G. National Aeronautics and Space Agency. *The Estimation of a Linear Regression System Obeying Two Different Regimes.* At times it may be difficult or undesirable to fit data to a single regression. Rather one may find advantage in fitting the data to two regressions of the following form:

$$\begin{aligned} y &= f(x) & \text{if } x_L \leq x = \eta \\ &= g(x) & \text{if } \eta = x \leq x_U . \end{aligned}$$

A method for estimating n , the separation point is suggested and for two special straight lines is tested by an empirical sampling experiment on a computer. An extrapolation on the computer results is then made in order to extend the findings to the more general case of any two straight lines.

12. MYERS, RAY. Virginia Polytechnic Institute. *Prediction of the Compositon of a Ternary Mixture.* This study is an investigation of various models for use in the determination of the content of a particular mixture. These models include equations relating composition with various physical properties of the system and chemical analyses of one or more of the components separately. The system used for this study was the ternary mixture containing nitroglycerine, 2-nitrodiphenylamine (2NDPA), and triacetin. Laboratory data on specific gravity and refractive index for the system and a chemical analysis of 2NDPA were obtained for various compositions. These data were used to aid in determining which of the models represents the most accurate source of prediction. The ultimate goal was to find the closest fitting model, and from it devise a systematic method in which the prediction of the composition of the mixture can be made quickly and accurately.

13. EISENHART, CHURCHILL, ANN DE VORE SMITH and JOHN VAN DYKE, National Bureau of Standards. *Probability Points of the Coverage Distributions Associated with Wilks' Unbiased Tolerance Intervals.* Let X_1, X_2, \dots, X_n denote independent normally distributed random variables with common mean μ and common standard deviation σ , let \bar{X} and S^2 be the usual unbiased sample estimates of μ and σ^2 , and let $P(k, n)$ be the proportion of the underlying normal distributions included between the limits $\bar{X} - kS$ and $\bar{X} + kS$, then $P(k, n)$ is also a random variable. Wilks (1941) showed that $E[P(k, n)] = p_0$ exactly for $k = k(p_0, n) = t_{1-p_0} \sqrt{(n+1)/n}$, where t_{1-p_0} is the two-tail $(1-p)$ -probability level of Student's t for $n-1$ degrees of freedom. Wald and Wolfowitz (1946) showed that, to an accuracy of $1/n^2$ or better

$$(1) \quad \text{Prob}[P(k, n) \geq p] = \text{Prob}[\chi^2_{n-1} \geq (n-1) r^2/k^2]$$

where χ^2_{n-1} has the χ^2 distribution for $n-1$ degrees of freedom, and $r = r(p, n)$ depends only on p and n , and has now been tabulated to 4D by Weissberg and Beatty (1960). Substituting the value $k = k(p_0, n)$, for chosen p_0 and n , in the right-hand side of (1), and taking $r = r(p, n)$ for $p = .50, .75, .90, .95, .99$ and $.999$ in succession, one can obtain the corresponding values of $\text{Prob}[P(k(p_0, n) \geq p)]$. Values so obtained for $p_0 = 0.95$ and $n = 5(1) 10, 12, 15, 20, 30, 60$, were plotted on normal-normal probability paper and the values of the .005, .01, .025, .05, .10, .20, .25, .50, .75, .80, .90, .95, .975, .99, and .995 probability points of $P(k(.95, n), n)$ obtained by graphical interpolation.

14. WATTERSON, G. A., Virginia Polytechnic Institute; F. V. AT-

KINSON, University of Toronto, and P. A. P. MORAN, Australian National University. *A Matrix Inequality.*

Let $\{a_{ij}\}$ be an m by n matrix of non-negative terms. Then

$$mn \sum_{i=1}^m \sum_{j=1}^n a_{ij}a_i \cdot a \cdot j > a^3 \dots,$$

where a_i and a_j are the row and column totals and a is the sum of all terms. The inequality proves the conjecture that the mean fitness of a biological population increases after random mating.

15. BAIRD, H. R., National Institute of Health and C. Y. KRAMER, Virginia Polytechnic Institute. *Analysis of Missing Values in a Balanced Incomplete Block Design.* The problem considered in this paper is that of estimating several missing values and analyzing the resulting augmented data in a balanced incomplete block design. The estimates are obtained by Yates' procedure of minimizing the error sum of squares. Explicit formulae are obtained for all cases involving not more than two missing values and for several particular configurations of the missing values within the design. A general solution is obtained which involves the inversion of a symmetric n -square matrix, where n is the number of missing values. An exact analysis of data augmented by missing value estimates is given which eliminates a positive bias in the treatment sum of squares. It is possible to treat a balanced incomplete block design as a randomized block design with missing values. Estimates of the missing entries and a randomized block analysis can then be obtained according to the method of Glenn and Kramer. An example of this procedure is given, and the results are compared with the results obtained by the usual balanced incomplete block analysis.

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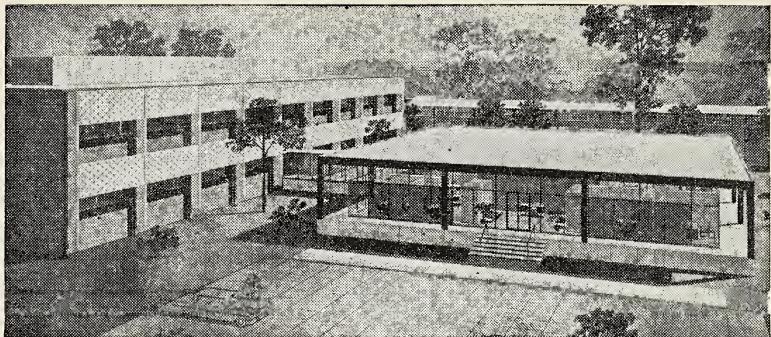
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